Muelleria

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Notes on Australian taxa of *Nymphoides* (Menyanthaceae): typification and nomenclature

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Introduction

This paper is presented as a precursor concerning type collections for any revision or Flora account of Australian *Nymphoides* taxa that may eventuate.

There are currently 20 species of *Nymphoides* Ség. (Menyanthaceae) recognised as occurring in Australia (Aston 2003). Those described since 1950 had their type collections clearly designated when first described, but are included here for completeness. Those described prior to 1950 were initially placed under the generic names of either *Limnanthemum* S.G.Gmel. or *Villarsia* Vent. and most of them have been treated, at one time or another, under all three generic names. This paper designates lectotypes where necessary, provides explanatory notes, and details the nomenclature and types for all Australian species except *N. indica* (L.) Kuntze and *N. parvifolia* (Griseb.) Kuntze. Although the two excluded species occur in Australia they were described from other countries and their typification has not been fully investigated by the author.

For species described before 1950, lectotypes are here designated for the currently accepted taxa *N. crenata* (F.Muell.) Kuntze, *N. exiliflora* (F.Muell.) Kuntze, *N. geminata* (R.Br.) Kuntze and *N. minima* (F.Muell.) Kuntze. They are also here designated for the taxonomic synonyms *N. hydrocharoides* (F.Muell.) Kuntze [under *N. aurantiaca*] and *Limnanthemum geminatum* (R.Br.) Griseb. var. *parvifolium* Griseb. [under *N. exiliflora* (F.Muell.) Kuntze]. *Villarsia geminata* var. β R.Br. is also placed under *N. exiliflora* and recognised as an informal synonym of *L. geminatum* var. *parvifolium*. Robert Brown's informal variety of *Villarsia geminata* var. α is placed with *N. geminata* (R.Br.) Kuntze. The holotype and possible isotypes of *N. exigua* (F.Muell.) Kuntze, the holotype and isotypes of *N. furculifolia* Specht, and the holotype of *Villarsia trachysperma* F.Muell. [a taxonomic synonym of *N. indica* (L.) Kuntze] are given. The holotype and isotype of *N. stygia* (J.M.Black) H.Eichler are given and the name is considered a *nomen ambiguum*. Basionyms and nomenclatural synonyms, all of which occur under the generic names of either *Limnanthemum* or *Villarsia*, are cited.

Abstract

Of the 20 species of *Nymphoides* Ség. (Menyanthaceae) currently recognised as occurring in Australia (Aston 2003), only those described since 1950 were initially named within this genus. Those described prior to 1950 were initially placed under the generic names of either *Limnanthemum* S.G.Gmel. or *Villorsia* Vent. and most have been treated, at one time or another, under all three genera. Nomenclature and explanatory notes relevant to all but two [*N. indico* (L) Kuntze & *N. porvifolia* (Griseb) Kuntze] of these early Australian taxa are provided with information on their type material. Lectotypes are designated where necessary. Species described under *Nymphoides* since 1950 are also included, together with their original type designations.

Several formal or informal names used for species of *Nymphoides* in *Aquotic Plonts of Australio* (Aston 1973) are now outdated. Corrections for these are included here.

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Lectotypes previously designated by other authors for *N. aurantiaca* (Dalzell) Kuntze and its taxonomic synonym *Villarsia aurantiaca* Ridl. ex C.B.Clarke are included. Although the type collections of these are extra-Australian, the species also occurs within Australia.

Species given names now placed in synonymy, or misapplied or informal names under *Nymphoides* in *Aquatic Plants of Australia* (Aston 1973), are included in this paper. The names as used there, with those which should now be used for them following in square brackets, are *N. geminata, sensu* Aston *op. cit.* 111, *non* (R.Br.) Kuntze [*N. montana* Aston], *N. hydrocharoides* [now a taxonomic synonym under *N. aurantiaca* (Dalzell) Kuntze], *N. stygia* [*nomen ambiguum*], *Nymphoides* sp. [*N. subacuta* Aston] and *Nymphoides* sp. aff. *exiliflora* [*N. geminata* (R.Br.) Kuntze].

Typification and Nomenclature

Nymphoides aurantiaca (Dalzell) Kuntze, (as *Nymphodes aurantiacum*), *Revis. gen. pl.* 2: 429 (1891).

Limnanthemum aurantiacum Dalzell in *Hooker's J. Bot. Kew Gard. Misc.* 2:136 (1850). *Type citation:* "Crescit prope Malwan; *fl.* Sept." *Type*: Bombay, India, *Dalzell s.n.*

Lectotype: K; *fide* Cramer, L.H. in Dassanayake, M.D., ed., *Revised Handb. Fl. Ceylon* 3: 211 (1981).

Villarsia aurantiaca Ridl. ex C.B.Clarke in King, G. and Gamble, J.S., *J. Asiat. Soc. Bengal* Pt. 2, *Nat. Hist.*, 74: 90 (1906). *Type citation:* "Pahang: Kwala Pahar, *Ridley*."

Lectotype: Peninsula Malaysia, Pahang, Kwala 'Pahar' (sphalm. for Pahang), *Ridley s.n.*, -.-.1890 (CAL 303131); possible isolectotype: Kwala Brawas, near Kwala Pahang, 14 May 1890, *Ridley 550* (SING); *fide* Cheek, M. and Turner, I.M., *Kew Bull.* 53: 964 (1998). See note 1 below.

Nymphoides hydrocharoides (F.Muell.) Kuntze, (as *Nymphodes hydrocharodes*), *Revis. gen. pl.* 2: 429 (1891). *Villarsia hydrocharoides* F.Muell., *Fragm.* 6: 139 (Mar. 1868). *Limnanthemum hydrocharoides* (F.Muell.) Benth., *Fl. austral.* 4: 380 (Dec.1868). *Type citation*: "Ad sinum Rockingham's Bay in stagnis. Dallachy."

Lectotype (here designated): Murray [River], Rockinghams Bay, Qld, *J. Dallachy s.n.*, 29.vi.1865 (MEL 1505007); apparent isolectotypes: MEL 1505008, MEL 1505009, BRI 010375; possible remaining syntypes: MEL 1505010, MEL 1505011, MEL 1505012, MEL 1505013. See note 2 below.

Note 1: Cheek and Turner (1998) located only one collection (CAL 303131) fitting Clarke's protologue ("Pahang: Kwala Pahar, Ridley") for *Villarsia aurantiaca* and from the main specimen label, which seemed to be in Ridley's hand, corrected Clarke's spelling "Pahar" to "Pahang". The label also gave Ridley's name as collector and 1890 as the year of collection, without precise date. A second label was signed and dated 26 October 1903, apparently in Clarke's hand, and bore information which is largely reproduced in Clarke's protologue of three years later. The only other Ridley collection which Cheek and Turner could locate was from Kwala Brawas, near Kwala Pahang, 14 May 1890, *Ridley 550* (SING). Because the species is rare in Malaysia, and because both collections were made in 1890, Cheek and Turner considered it possible that the CAL collection may be "merely a cursorily labelled duplicate" of *Ridley 550* sent by Ridley to Clarke at some stage prior to Clarke's annotation of it in 1903.

In referring to the *Ridley s.n.* collection he was using, Clarke stated that "This example shows no fruit..." which, because of the importance of seed micromorphology and size in distinguishing species within Menyanthaceae (e.g. Sivarajan *et al.* 1989; Chuang & Ornduff 1992; Sivarajan & Joseph 1993; Aston 2003), is unfortunate. Cheek and Turner (1998) therefore prepared scanning electron micrographs of the seed from the possible isolectotype *Ridley 550* (SING) and from other Malaysian specimens considered to be *V. aurantiaca*. Comparison of these scans with published SEM photos of Indian seeds of *Nymphoides aurantiaca* (Sivarajan & Joseph 1993) showed the two entities to be conspecific.

Ridley had annotated the unnumbered collection he sent to Clarke as *Villarsia aurantiaca* without reference to any other genus. Clarke accepted Ridley's name, again without mention of the epithet's earlier association with both *Nymphoides* and *Limnanthemum*. Cheek and Turner (1998) rightly treated *V. aurantiaca* as a new name and not just a new combination.

Note 2: The National Herbarium of Victoria (MEL) has seven sheets of material from Rockingham Bay that can be considered as possible syntype collections of

Nymphoides hydrocharoides. Only two of these are dated and, from a plain label "never can get much of this in flower" in Dallachy's hand on one sheet (MEL 1505013), it is evident that he made more than one collection of the species. Some undated material may have been collected after publication of the basionym in 1868. Only one sheet (MEL 1505007) gives a location more precise than "Rockingham(s) Bay", indicating the Murray River which flows into the Bay north of Cardwell. This sheet is dated and holds both labels and plant material which make it suitable for selection as the lectotype.

The lectotype designated bears Dallachy's plain label "Murray 29 Jun 1865" in his hand, and an additional blue "Botanical Museum of Melbourne" label stating "Rockinghams Bay". The blue label has Mueller's identification of *Villarsia hydrocharoides* in his handwriting, and also the initial "B" to indicate it has been seen by Bentham. The apparent isolectotype MEL 1505008 lacks the collector's name and any date but it bears a blue label with "Rockingham's Bay" and "*Villarsia hydrocharoides*" both in Mueller's hand, and also bears Bentham's initial. It is very well matched botanically with the lectotype, more so than any of the other sheets considered. The apparent isolectotype MEL 1505009 has Dallachy's plain label bearing field notes and "29 June 1865 Rockingham Bay" all in his hand, the identification *V. hydrocharoides* written by Mueller, and Bentham's initial.

The BRI 010375 sheet of apparent isolectotype material bears two plant portions that match the three portions on MEL 1505009. The BRI material would have been donated by MEL before the MEL material was mounted on the current sheets. The label on the BRI sheet is handwritten by the late J.H. Willis of MEL, who combined the basic information from MEL labels into "Rockingham Bay, N.Q'land. – in swamps", "John Dallachy" and "June 1865". His words include elaborations that do not appear on any of the MEL labels: "in swamps" must have been taken from "*in stagnis*" in the type citation.

Labels on the four sheets of "possible remaining syntype" material at MEL are inadequate to allow any certainty that they could be part of the lectotype collection. They are all undated and may or may not have been seen by Mueller in time for him to have considered them when preparing his description of *V. hydrocharoides*.

Nymphoides beaglensis **Aston, *Muelleria* 6: 359 (1987).**

Type citation: "8 km east of Beagle Bay Mission, Dampierland Peninsula, in permanent pool known locally as 'Bunguaduk', 16°58'S, 122°44'E, Kimberley Region, Western Australia, 20.viii.1985, *K.F. Kenneally 9451*."

Holotype: PERTH; isotypes: MEL 1549338, PERTH (spirit).

Nymphoides crenata **(F.Muell.) Kuntze, (as *Nymphodes crenatum*), *Rev. gen. pl.* 2: 429 (1891).**

Limnanthemum crenatum F.Muell., *Trans. Philos. Soc. Victoria* 1: 17 (1854). *Villarsia crenata* (F.Muell.) F.Muell., *Fragm.* 4: 127 (1864). *Type citation*: "In tranquil bends of the Murray River, Murrumbidgee, and Mitta Mitta, and in the nearest lakes and lagoons."

Lectotype (here designated): K; isolectotypes: MEL 2182281, 2182282, 2182283; probable isolectotype: MEL 1505131.

The lectotype sheet at K, although undated, bears a blue label with "Limnanthemum crenatum/ ferd Mueller/ Murray" in Mueller's hand. The specimen includes buds, flowers, fruit and seeds, and is the most complete of all type sheets seen.

All sheets at MEL are also undated. Two of the isolectotype sheets have a blue, printed "BOTANICAL MUSEUM OF MELBOURNE/ FERD. MUELLER, PH. & M.D." label annotated "Villarsia crenata/ ferd. Mueller/ Murray" in Mueller's hand, and initialled by Bentham. They also have labels or packets annotated by Mueller as "Limnanthemum crenatum ferd Mueller". The third isolectotype sheet bears only one plain blue unprinted label annotated by Mueller with "Limnanthemum/ crenatum/ ferd Mueller/ Murray/ Dr ferd Mueller".

The probable isolectotype sheet bears a label written in scripted handwriting of the kind that used to be used on the front of specimen display folders at MEL (in the early 1900s?). The label reads "Limnanthemum crenatum", with the words below repeating those of Mueller's type citation. Although collector and date are not given, it was not unusual for herbarium material to be used in display. The plant portions mounted on this sheet match with those of the isolectotypes and appear to be part of the same collection. Unfortunately, this is the most botanically complete sheet at MEL. It includes

a packet containing many seeds whereas a few seeds are present on only one of the isolectotype sheets.

Mueller's description and type citation of *Limnanthemum crenatum* was repeated in *Hooker's J. Bot. Kew Gard. Misc.* 8: 164 (1856).

***Nymphoides disperma* Aston, *Muelleria* 6: 197 (1986).**

Type citation: "Unnamed creek running into Pauline Bay, Vansittart Bay, Northern Kimberley, Western Australia, 14°12'30"S, 126°22'E, 22.v.1984, *S.J. Forbes 2098*."

Holotype: MEL 672226; isotypes: MEL 672227, MEL 2329836 (spirit), PERTH.

***Nymphoides elliptica* Aston, *Muelleria* 5: 268 (1984).**

Type citation: "10.3 km east of 'Musgrave' along the 'Marina Plains' road, 14°45'S, 143°3S'E, Cape York Peninsula, Queensland, 13.v.1982, *Aston 2260*."

Holotype: MEL 612197; isotypes: BRI, CANB, K, MEL 612198 and 612199, MEL 2320257 (spirit).

***Nymphoides exigua* (F.Muell.) Kuntze, (as *Nymphodes exiguum*), *Rev. gen. pl.* 2: 429 (1891).**

Limnanthemum exiguum F.Muell., *Fragm.* 1: 40 (1858). *Villarsia exigua* (F.Muell.) Hook.f., *Fl. Tasman.* 2: 368 (1859). *Villarsia exigua* (F.Muell.) F.Muell., *Fragm.* 4: 128 (1864), *nom. illeg.*, later homonym. *Type citation*: "In paludibus subsalinis ad South Port Tasmaniae legit. *Oldfield*".

Holotype: Sheet bearing a field label "Wet muddy/ places in/ brackish/ water/ South Port" and with "Hb. Oldfield" added at the label top, all in the hand of A. Oldfield, also "Limnanthemum/ exiguum" in Mueller's hand at bottom of label, with "(Gentianaceae)" below; no date given (K 449394); possible isotypes: MEL 1505253, MEL 1505254 (see notes below).

Although Mueller saw and annotated the holotype material held at K, no definite isotype material has been located at MEL where it might be expected. MEL has no Southport collection gathered by Oldfield, but has Southport material collected by C. Stuart and there is a slim possibility that the K and MEL sheets hold parts of a joint Stuart/Oldfield collection. This possibility is explained below. Of the two relevant sheets at MEL, one (MEL 1505253) bears a field label "1781/ Aquatic/ South Port/ fl yellow/Dec/56" [i.e. 1856] in Stuart's hand, with "Limnanthemum/ exiguum/ ferd Mueller" added by Mueller. There is also an attached packet annotated on the outside with "South Port/ V.D.L. St" in Stuart's hand, and the identification "Limnanthemum/ (Liparophyllum)/ exiguum/ ferd. Mueller" in Mueller's hand. Inside the packet is a loose label with "South Port/ Dec 55/ Water" [note 1855 at variance from 1856 on other label] in Stuart's hand and "Limnanthemum exiguum" added by Mueller. The sheet also has a standard blue printed label "BOTANICAL MUSEUM OF MELBOURNE/ FERD. MUELLER, PH. & M.D." annotated by Mueller with "Villarsia exigua/ ferd Mueller/ Van Diemen's Land", and has several specimens mounted on it. A second sheet (MEL 1505254) has several specimens in a packet bearing "Limnanthemum/ exiguum/ ferd Mueller" in Mueller's hand, and "South Port/ V.D.L." in Stuart's hand.

The presence of two different dates (Dec. 55 and Dec. 56) on the Stuart material of MEL 1505253 raises the question of whether all the Stuart material on the two MEL sheets could have come from two different collections. If so, these collections may have been incorrectly amalgamated over the years before becoming mounted on the current sheets. Alternatively one date may be in error, in which case all material should belong to the one collection only.

G. Bentham has initialled the packet and blue label on MEL 1505253, indicating that he saw the Stuart material held at MEL. In *Fl. austral.* 4: 381 (1868) Bentham cited his examination of *L. exigua* from "South Port, *C. Stuart*" but did not mention any Oldfield collection of the species. It seems that he probably had reason for believing that the holotype material at K had been collected by Stuart (see next paragraph).

Helen Henderson (pers. comm.) of Perth, Western Australia, who is preparing a database of her and her husband's researches into Oldfield's collections, has provided information concerning joint collecting of Oldfield and Stuart in south-east Tasmania. Stuart was in the area from September 1855 to April 1856, and Oldfield met up with him at Southport in either very late December 1855 or very early January 1856 to collect for about ten days. A second joint trip of late February and early March 1857 does not involve *N. exigua*.

From the information above it can be seen that there is a possibility that the holotype at K, supposed by Mueller to have been collected by Oldfield, and the Stuart collections at MEL (or some of this Stuart material) may have been jointly collected. The label on the holotype is in Oldfield's hand and effectively has the same habitat and locality data in English as that published in Latin by Mueller. However, Oldfield has not indicated who made the collection but has instead annotated the label as being from his herbarium. The K and MEL material could all be part of a Stuart collection, some of which was given to Oldfield by Stuart for Oldfield's own herbarium. If that is so, then the MEL sheets would be isotypes. An alternative, that the holotype is an independent collection of Oldfield's, seems less likely because it consists of only two small plants and Oldfield normally collected in greater quantity.

Nymphoides exiliflora **(F.Muell.) Kuntze, *Revis. gen. pl.* 2: 429 (1891).**

Villarsia exilifloro F.Muell., *Frogm.* 5: 46 (July 1865). *Limnonthemum exiliflorum* (F. Muell.) Benth., *Fl. oustrol.* 4: 381 (1868). *Type citotion*: "In aquis stagnantibus ad sinum marinum Rockingham's 8ay. *Dallochy*."

Lectotype (here designated): "1st May 1865 Growing in moist places flower yellow ..." in Dallachy's hand, with "Villarsia exiliflora ..." added by Mueller, and "Rockingham's Bay" (MEL 1505001); remaining syntype: "Moist places a beautiful little plant – small yellow flowers ... 1865 5 and 6 April ..." in Dallachy's hand with "Villarsia exiliflora ..." and "Rockingham's Bay" added by Mueller (MEL 1505002); possible syntypes (collections undated): Sheet with printed "PHYTOLOGIC MUSEUM OF MELBOURNE / BARON FERD. VON MUELLER, PH. & M.D., LL.D." label bearing handwritten "Rockingham's 8ay, Queensland. / Dallachy" (GOET). Sheet with blue printed "BOTANICAL MUSEUM OF MELBOURNE" label and "Rockingham's Bay, Villarsia exiliflora ferd. Mueller" in Mueller's hand, collector not given (L). "Rockingham's Bay, J. Dallachy" (MEL 1505003 & 1505004).

Limnonthemum geminatum (R.Br.) Griseb., *Gen. sp. Gent.* 346 (1838, in error 1839) var. *porvifolium* Griseb., (as β *porvifolia*), *loc. cit. Type citotion*: "in litore inter tropicos (Br.), pr. York-Sound (Cunningham!)".

Lectotype (here designated): Sheet with printed "R. 8rown, Iter Australiense, 1802-5" label numbered 2982, printed "Type Specimen" label, and with two near-identical labels stating "Menyanthes [Nymphoides crossed out] caespitosa / Desc port No 89 a Shoalwater 8ay / in humidus" in R. 8rown's hand (8M); probable isolectotypes: "Menyanthes geminata / Port Jackson" *pro porte*, as to specimen at top right of sheet (BM). Printed "R. Brown, Iter Australiense, 1802-5" label numbered 2982 and label "Menyanthes caespitosa Shoalwater Bay Towards the Conical Hill" in Brown's hand, upper specimens on mixed sheet [excl. lower specimens from "Nepean"] (K). "Limnanthemum geminatum / Menyanthes caespitosa/ ... / Shoalwater Bay" (MEL 1505006)! Sheet with "Limnanthemum geminatum (Menyanthes caespitosa Hb. 8r.) Shoalwater 8ay" apparently in 8rown's hand, and also a Herb. Mus. Paris label printed "Australie/ Robert Brown/ Envoi du Jardin royal de Kew/ Recu le 19 Janvier 1884." (P).

Villorsio geminoto var. β R.Br., *Prodr.* 457 (1810). "(T.) *v.v.*"

Although Grisebach, *loc. cit.*, cited two collections when designating the varietal epithet *porvifolium* for Brown's informal variety β, he clearly used 8rown's *Prodr.* as the primary basis for acceptance of the variety and for the provision of his own epithet for it. It is therefore fitting to choose Brown's Shoalwater Bay (Queensland) material as lectotype although Grisebach's text indicates that he did not see Brown's material. The Cunningham collections, made in 1820, from York Sound (Kimberleys, Western Australia) and seen by Grisebach are well outside the currently known range of *Nymphoides exilifloro* and possibly represent a different entity to Brown's collection. Articles 9.1, 9.2 and 9.9 of the *Internotionol Code* (McNeill *et ol.* 2006) cover a situation of this kind.

See also notes under *Nymphoides geminoto* (R.Br.) Kuntze concerning Brown's informal varieties.

Nymphoides furculifolia **Specht, (as *Nymphoides furculaefolia*) in Specht, R.L. & Mountford, C.P. (eds), *Rec. American-Australian Scientific Exped. Arnhem Land* 3: 280 (1958).**

Type citotion: "South Bay, Bickerton Island (waterhole in sandstone hills): 455. Hyd. Type – Brisbane (BRI)."

Holotype: (BRI 017792); isotypes: (AD 96149108, K, MEL 595587, NSW). Each type has a printed Expedition label enlarging information in the type citation, e.g. giving "South Bay, Bickerton Island, in the Gulf of Carpentaria (13°45'S, 136°6'E)", collection date 5 June 1948, and collector *R.L. Specht 455*.

Nymphoides geminata (R.Br.) Kuntze, as *Nymphodes geminatum*, ***Rev. gen .pl.*** 2: 429 (1891).

Villarsia geminata R.Br., *Prodr.* 457 (1810) *pro parte*, as to var. α, excl. var. β. *Limnanthemum geminatum* (R.Br.) Griseb., *Gen. sp. Gent.* 346 (1838, in error 1839), *pro parte*, as to var. α, excl. var. *parvifolium* Griseb., (as β *parvifolia*), and excl. *Villarsia sarmentosa* Sims. *Type citation*: "(J.) *v.v.*", R. Brown.

Lectotype (here designated): Sheet with "R. Brown, Iter Australiense, 1802-5" printed label, numbered 2982, and with two labels in Brown's hand, these being "Villarsia [above a ruled through Menyanthes] geminata / α prodr 457 / Nepean / 1804 December" and "Menyanthes elatior / Nepean opposite Thomsons / Land / Decr 1804" (BM); possible isolectotype: "R. Brown, Iter Australiense, 1802-5" printed label, numbered 2982, and handwritten "Nepean", excl. upper specimens from Shoalwater Bay (K); remaining syntypes: "Menyanthes geminata / Port Jackson" *pro parte*, excl. specimen at top right, coll. R. Brown (BM). "R.Brown, Iter Australiense, 1802-5" printed label, and handwritten [apparently by Brown] label "Menyanthes geminata / Port Jackson" (MEL 1505005). "Menyanthes geminata Flooded banks of the Nepean 1805" in Brown's hand (K).

[*Nymphoides* sp. aff. *exiliflora*, *sensu* Aston, *Aquatic Pl. Australia* 117 (1973)]

In describing the basionym *Villarsia geminata*, R. Brown, *loc. cit.*, recorded two infraspecific taxa, α and β. Taxon α was said to have subcoriaceous leaves 2.5–5 cm in diameter, with upper and lower surfaces differently coloured, and to have been collected by Brown from "(J)" [New South Wales]. Taxon β had smaller membranous leaves about 1.2–2 cm diameter with both surfaces similarly coloured, was sometimes stemless, and was collected from "(T)" [tropical Australia]. Brown expressed uncertainty as to the taxa, describing β as "Forsan distincta", i.e. perhaps distinct, and did not formally name them or indicate their taxonomic rank. Under *Limnanthemum geminatum*, Grisebach *loc. cit.*, retained Brown's taxa and their designations of α and β, and also validly published the epithet *parvifolium* (as β *parvifolia*) for β. Under Article 35.4 of the International Code (McNeill *et al.* 2006) this epithet must be regarded as having the rank of variety. In publishing the var. *parvifolium* Grisebach automatically established the autonym *L. geminatum* var. *geminatum* for the taxon α (McNeill *et al.* 2006, article 26.3).

In this paper *L. geminatum* var. *parvifolium* is placed as a taxonomic synonym of *Nymphoides exiliflora*, and a lectotype for the varietal name has been designated in the account of that species, *q.v.*

Nymphoides geminata sensu Aston, ***Aquatic Pl. Australia*** 111 (1973), ***non*** (R.Br.) Kuntze.

Now *N. montana* Aston, *q.v.*

Nymphoides hydrocharoides (F. Muell.) Kuntze.

Now a taxonomic synonym under *N. aurantiaca* (Dalzell) Kuntze, *q.v.*

Nymphoides minima (F.Muell.) Kuntze, (as *Nymphodes minimum*), ***Revis. gen. pl.*** 2: 429 (1891).

Limnanthemum minimum F.Muell. *Fragm.* 1: 40 (1858). *Villarsia minima* (F.Muell.) F.Muell. *Fragm.* 4: 128 (1864). Type citation: "In stagnis aqua limpida repletis flumen Fitzmaurice versus."

Lectotype (here designated): Sheet with plain label stating "Limnanthemum/ minimum, ferd. Mueller/ Fresh stagnant waters near/ the upper Fitzmaurice/ Oct 55. ferd. Mueller" [c.14°50'S, 130°45'E] in Mueller's hand, and a blue printed "BOTANICAL MUSEUM OF MELBOURNE / ferd. Mueller, PH. & M.D." label with "*Villarsia minima*/ ferd. Mueller/ Arnhem's Land" in Mueller's hand and initialled by Bentham (MEL 1505000); isolectotype: Specimen in type folder with label "Limnanthemum minimum ferd Mueller/ Fitzmaurice River Oct. 55 ferd Mueller." in Mueller's hand (K). The sheet at K also contains a Cunningham collection that is not part of the type.

Nymphoides montana Aston, ***Muelleria*** 5: 36 (1982).

Type citation: "Lake Hill, south-west of Nunniong Plains, East Gippsland, Victoria, grid W6(-3), 20.i.1971, *Beauglehole & Finck ACB36345*."

Holotype: MEL 1504963; isotypes: BRI, CANB, MEL 1504964, MEL 1504965, NSW. Paratype also cited: "Morass Creek, about 9 km north of Benambra, at crossing of the Omeo to Corryong road, 36°52'S, 147°42'E, Victoria, 12.iii.1975, *Aston 1852*." MEL 1504989 to 1504999, MEL 2326032 (spirit), NSW.

[*Nymphoides geminata sensu* Aston, *Aquatic Pl. Australia* 111 (1973), *non* (R.Br.) Kuntze]

Nymphoides planosperma Aston, ***Muelleria*** 5: 39 (1982).

Type citation: " Northern Territory, Kakadu National Park, c. 22 km north-east of Jabiru, 12°31'S, 132°58.5'E, 30.iii.1981, *Craven 6607*."

Holotype: MEL 1520239; isotypes: CANB (not seen), MEL 1520238, MEL 2327964 (spirit). [Also other material awaiting distribution from CANB at the time the name was published, and not seen by Aston.]

Nymphoides quadriloba Aston, ***Muelleria*** 5: 42 (1982).

Type citation: "About 3 miles NNE of Katherine, Northern Territory, 10.iv.1967, *Adams 1747*." [Incorrectly given as c. 2 miles north of Katherine on at least the K and NT isotype sheets but corrected on the CANB sheet to the citation quoted above.]

Holotype: CANB 172340; isotypes: CANB 172339, CANB (spirit), K, NSW, NT 39334, also (not seen by Aston) A, E, L, US. Paratype also cited: "Property of L.J. Phillips, about 5–8 km NNE. of Katherine, c. 14°25'S, 132°18'E, Northern Territory, 7.v.1976, *Aston 1898*." BRI, CANB, MEL 1505244 , MEL 1505245, MEL 2320273 (spirit), PERTH.

Nymphoides simulans Aston, ***Muelleria*** 16: 83 (2002).

Type citation: "Queensland, Cape York Peninsula, 3.2 km E of 'Musgrave' along the 'Musgrave' to 'Marina Plains' road, 13 May 1982, *H.I. Aston 2255*."

Holotype: MEL 612170; isotypes: BRI, MEL 612171, MEL 2173027 (spirit).

Nymphoides spinulosperma Aston, ***Muelleria*** 10: 21 (1997).

Type citation: "Victoria, Wimmera, c. 5.5 km (in a straight line) WNW of St Arnaud, along the St Arnaud–Bayena Rd, altitude 160 m, *H.I. Aston 2872*, 21.i.1996."

Holotype: MEL 2031021; isotypes: MEL 2031022, MEL 2031023, MEL 2037992 (spirit), NSW.

Nymphoides spongiosa Aston, ***Muelleria*** 5: 45 (1982).

Type citation: "About 6 km east of the Howard River crossing of the Howard Springs to 'Koolpinyah' road, 12°26'S, 131°08'E, Northern Territory, 17.v.1976, *Aston 1936*."

Holotype: MEL 150S146; isotypes: CANB, MEL 1505145, MEL 2300180 (spirit), NT.

Nymphoides* sp. *sensu Aston, ***Aquatic Pl. Australia*** 117 (1973).

Now *N. subacuta* Aston, *q.v.*

Nymphoides* sp. aff. *exiliflora sensu Aston, *Aquatic Pl. Australia* 117 (1973).

Correctly *N. geminata* (R.Br.) Kuntze, *q.v.*

Nymphoides stygia (J.M.Black) H.Eichler, (as *N. stygium*), ***Taxon*** 12: 296 (1963).

Limnanthemum stygium J.M.Black, *Trans. & Proc. Roy. Soc. South Australia* 42: S2, tab. 6 (1918). *Type citation*: "Dismal swamp, 15 miles north of Mount Gambier."

Holotype: Dismal Swamp, N of Mt Gambier, *J.M. Black s.n.*, 4 or 6.xii.1917 (AD); isotype: (K).

Black, *loc. cit.*, stated "fructu ignoto" in his description, and the fragmentary type material is deficient in showing diagnostic characters of inflorescence, infructescence and seed. Originally (Aston 1973) I accepted the name as representing a distinct species. Later (Aston 1986) I considered *Nymphoides stygia* was described from a depauperate plant of *Villarsia reniformis* R.Br. as the specimens, and figures published by Black, all represent a species of *Villarsia*. However, from the leaf shape it is perhaps more likely that it should be placed with one of the two varieties of *V. umbricola* Aston. These varieties can only be distinguished by the seeds (Aston 1969). It seems that the identity of the *Villarsia* taxon to which the name

Nymphoides stygia applies remains inconclusive, and the name is best considered a *nomen ambiguum*.

Nymphoides subacuta Aston, *Muelleria* 5: 48 (1982).

Type citation: "McMinns Lagoon, approximately 30 km E5E of Darwin city centre, 12°31'S, 131°05'E, Northern Territory, 20.v.1976, *Aston 1954*."

Holotype: Long-styled plant *Aston 1954A*, MEL 1505123; isotype: CANB. Paratypes also cited: Short-styled plant *Aston 1954B*, DNA; Short-styled plant *Aston 1954C*, MEL 1505122, MEL 1505124; Style unspecified, leaves only, showing variation, MEL 1505125. [Also MEL spirit of isotype and paratype material. All plants of *Aston 1954* were collected within three metres of each other].

[*Nymphoides* sp. *sensu* Aston, *Aquatic Pl. Australia* 117 (1973)]

Nymphoides triangularis Aston, *Muelleria* 5: 265 (1984).

Type citation: "14.8 km east of 'Musgrave' along the 'Marina Plains' road, 14°44'S, 143°37'E, Cape York Peninsula, Queensland, 13.v.1982, *Aston 2262*."

Holotype: MEL 612194; isotypes: BRI, CANB, MEL 612195, MEL 612196, MEL 2320253 (spirit).

Villarsia trachysperma F.Muell., *Fragm.* 6: 136 (1868).

Type citation: "In lacunis juxta fluvium 5outh Alligator-River. F.M."

Holotype: 5heet wth plain white pencilled label "Lagoons of the tribu/ tary of the S. Alligator/ River 5 July 56" and a blue printed "BOTANICAL MUSEUM OF MELBOURNE./ FERD. MUELLER, PH. & M.D." label bearing, all in Mueller's hand, "Villarsia trachysperma F.v. M./ S. Alligator River" plus descriptive notes. (MEL 681834).

This has long been accepted, correctly, as a taxonomic synonym of the cosmopolitan species *Nymphoides indica* (L.) Kuntze, (as *Nymphodes indicum*), *Revis. gen. pl.* 2: 429 (1891). *Menyanthes indica* L. *Sp. pl.* 207 (1753). Note that Mueller never collected on the South Alligator River or its tributaries, having gone no further north towards that area than the vicinity of the Elsey Creek and Roper River (Gregory 1884). His collecting locality for the holotype remains unclear, but on July 5, 1856, he was en route between the Victoria River and Elsey Creek.

The blue label cited here, and another on the holotype sheet, have both been seen and initialled by Bentham. I have not located any other possible type material held elsewhere, and an additional check by J. Bruhl (while ABLO) of K and BM specimens also proved negative. I therefore regard the MEL sheet as a unicate returned from K by Bentham after his examination of it.

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I wish to thank the directors and staff of all the herbaria cited, both Australian and ex-Australian, for allowing me access to their collections. I thank Dr Jeremy Bruhl who, while ABLO at Kew, UK, provided additional comment and digital photos from K and BM in relation to possible type material of *Nymphoides exigua* and *Villarsia trachysperma*. My thanks also go to Dr Helen Henderson, Shenton Park, Western Australia, for sharing with me her knowledge of the joint field work of Oldfield and Stuart in Tasmania.

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The willows (*Salix* – Salicaceae) in Tasmania

ex 253189

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Introduction

The genus *Salix* (willows) has a widespread native distribution concentrated mainly in temperate to sub-arctic regions of the Northern Hemisphere, but scattered in Argentina, Chile, South Africa and Madagascar. Some species are native in tropical areas of central America, Africa and south-east Asia. The genus is not native in Australasia. Recent estimates suggest that *Salix* contains 300–520 species (Cronquist 1988; Newsholme 1992; Argus 1997; Mabberley 1997; Fang *et al.* 1999). Together with the genus *Populus* L., it is in the family Salicaceae Mirb. Sometimes a third genus, *Chosenia* Nakai is also recognised, although this is often subsumed within *Salix*. The taxonomy of the Salicaceae, discussing generic limitations, is given by Skvortsov (1999) and Ohashi (2001). The Tasmanian taxa are in two subgenera: subgenus *Salix* (tree willows) and subgenus *Vetrix* Dumort. (shrub willows). Many species of *Salix* are used for timber production, basket making, soil stabilisation, windbreaks, fodder, medicine and as cultivated ornamentals. These practical values have significantly extended the distribution of the genus.

In Tasmania, several taxa of *Salix* have been widely planted and can be found as ornamentals in parks, gardens and open spaces such as roadside corridors. In rural areas, they are grown commonly for windbreaks and hedgerows, and on the banks of watercourses for consolidation. Several taxa are naturalised throughout the state whereas others have the potential to become naturalised. It is the principle aim of this paper to discuss the names that have been used in the past and to offer correct, or at least consistent, names for the plants that occur in Tasmania.

History of *Salix* in Tasmania

Early records of *Salix* in Tasmania include Bunce (1836), a Tasmanian nursery catalogue thought to be the first of its kind in Australia; it cites 'Willow'. Another early record is in Newman's (1857) *Catalogue of Plants in the Royal Society's Gardens,* which lists two taxa: *S. babylonica* L. and *S. forbiana* (the latter possibly a plant now known as *S.* ×*forbyana* Sm.). Both of these species are not known to grow in Tasmania today.

Abstract

The genus *Salix* L. in Tasmania is wholly alien, having been introduced as cultivated plants. Several taxa have become naturalised, whilst others are potential sources of naturalised taxa. The naturalised taxa are: *S. fragilis* L. var. *fragilis*, *S.* ×*reichardtii* A.Kern., *S. cinerea* L. subsp. *cinerea* and *S. cinerea* subsp. *aleifolia* (Sm.) Macreight. Taxa that are not fully naturalised are: *S. alba* L. var. *vitellina* (L.) Stokes, *S.* ×*rubens* Schrank, *S.* ×*sepulcralis* Simonk. nothovar. *chrysacama* (Dode) Meikle, *S. matsudana* Kaidz., 'Tartuasa', *S.* ×*caladendran* Wimm., *S. purpurea* L. Taxa that are common in Tasmania but only known from cultivation are: *S. humbaldtiana* Willd. 'Pyramidalis', *S. matsudana* × *S. alba* and *S.* ×*pendulina* Wender. var. *pendulina*. The taxa are described and illustrated, and their identification, distribution, habitat and status are discussed.

Muelleria 27(2): 127-148 (2009)

Royal Botanic Gardens Melbourne

Since then, many willows have been introduced into Tasmania, sometimes as many as 100 taxa at a time. Two such introductions occurred in 1878 and 1880 (Anon. 1879; 1881), when large consignments were sent from Kew Gardens in Britain to the Royal Society Garden in Tasmania (now the Royal Tasmanian Botanical Gardens):

> '...Plants and seeds received at the Botanic Gardens:– From the Royal Gardens, Kew, 100 varieties willow, most of which are alive...' (Anon. 1879).

> '...From the Royal Gardens, Kew, was received a box containing upwards of 100 varieties of willow cuttings; but, unfortunately, arriving in the heat of summer all efforts to retain viability in them proved futile, and, with the exception of two varieties, all perished...' (Anon. 1881).

In more recent times, introductions of *Salix* to Tasmania include the importation of hybrid willows (*S. matsudana* × *S. alba*), developed in New Zealand for soil stabilisation and as windbreak species, and released to Australia in the 1970s (Cremer *et al.* 1995).

Although records, like the ones mentioned above, suggest that a large number of taxa have been introduced, only a relatively small number are commonly encountered in cultivation within the state.

Several *Salix* taxa are serious weeds across south-eastern Australia, including Tasmania. These problem species infest stream banks and wetlands. Their presence impacts negatively upon stream hydrology, displaces and modifies native biodiversity, and causes chemical imbalances in the waterways (ARMCANZ 2001).

There are two groups of naturalised willow in Tasmania. The first contains taxa that spread and become naturalised via vegetative reproduction. Of this group, *S. fragilis* var. *fragilis* is an extreme example. This species infests vast lengths of waterways in Tasmania and on mainland Australia. Its stems are very brittle, especially at the junctions, and break away from the parent plant when disturbed, for example in windy weather. These liberated stem fragments readily root and, if they come to rest in a suitable environment such as a stream bank, they will establish into mature plants. Detached stems of willows, in general, readily produce roots in moist conditions. Hence, other taxa with less brittle stems can also spread in this way. However, their spread is usually facilitated by cultivation rather than natural means. The second group contains taxa that spread and become naturalised via sexual reproduction. Generally only a single sex of each taxon is present in Tasmania (exceptions include *S. cinerea*, *S. matsudana* × *S. alba* hybrids and *S.* ×*sepulcralis* nothovar. *chrysocoma*). For example, all *S. fragilis* var. *fragilis* plants in Tasmania are male. This restricts its reproduction to vegetative methods. The taxa that are present as both male and female plants can produce viable seed when growing together. In addition to this, willows can hybridise, allowing compatible taxa of opposite sex to breed. The seed that results from sexual reproduction has a tuft of fine, silky hairs enabling it to be transported by wind as well as on water currents. If transported to suitable habitats, such as wetlands and stream banks, the seeds can germinate and grow into mature plants. The ability of these plants to produce wind-borne propagules and be highly invasive in wet habitats makes them a significant weed threat in Tasmania. There is potential for some willows to reproduce and spread via both sexual and vegetative means. For example, *S. fragilis* var. *fragilis*, as mentioned above is highly adapted to spreading by fallen stems, it is also thought to have hybridised with *S. matsudana* 'Tortuosa'.

Prior to 1999, willows could be freely traded, propagated and planted throughout the state. The weedy nature of certain willow species, coupled with the large number of species that could possibly be introduced to Tasmania with unknown potential weed impacts, has seen the preventative regulation of the genus *Salix*, via the Tasmanian *Weed Management Act 1999*. Under this *Act*, all willows except for three taxa (*S. babylonica*, *S.* ×*calodendron* and *S.* ×*reichardtii*) are declared species in Tasmania. Management and control of the declared taxa depends heavily on an understanding of their taxonomy, biology, and ecology. In Tasmania, this information has been largely anecdotal and inconsistent, and it is the aim of this paper to clarify these details.

Published accounts of *Salix* relevant to Tasmania are Curtis (1967), Rodd (1982), Carr (1996) and Jacobs and Murray (2000), as well as the current *Census of Vascular Plants of Tasmania* (Buchanan 2007) – see Table 1. Curtis (1967) is strictly about *Salix* in Tasmania, but is based on very few Herbarium records. Rodd (1982), the *Flora of Australia* account, is also based on

Table 1. Summary *af* Tasmanian *Salix* taxa treated in previaus warks.

Curtis 1967*	Rodd 1982	Carr 1996	Jacobs & Murray 2000	Buchanan 2007	Baker 2009
S. babylanica	*S. babylonica*	*S. babylanica*	*S. babylonica*	*S. babylanica*	*S.* ×*pendulina* var. *pendulina*
S. alba × *fragilis*	*S. fragilis***	*S.* ×*rubens*	*S.* ×*rubens*	*S.* ×*rubens*	***S. fragilis* var. *fragilis***
S. atrocinerea	*S. cinerea*	*S. cinerea* subsp. *cinerea*	*S. cinerea*	*S. cinerea*	***S.* ×*reichardtii***
	S. alba	*S. alba* var. *alba*		*S. alba*	***S. fragilis* var. *fragilis***
		S. fragilis var. *fragilis*	*S. fragilis* var. *fragilis*	*S. fragilis*	***S. fragilis* var. *fragilis***
		S. alba var. *vitellina*	*S. alba* var. *vitellina*		*S. alba* var. *vitellina*
		S. ×*sepulcralis* var. *chrysocama*	*S.* ×*sepulcralis* var. *chrysacama*		*S.* ×*sepulcralis* nothovar. *chrysocama*
					S. cinerea* subsp. *cinerea
					S. cinerea* subsp. *oleifolia
					S. matsudana 'Tortuosa'
					S. ×*rubens*
					S. matsudana × *S. alba*
					S. ×*calodendron*
					S. purpurea
					S. humboldtiana 'Pyramidalis'

*Curtis (1967) also remarks that other species of *Salix* are cultivated in Tasmania and may be established locally.

** Rodd (1982) states '...no Australian specimens appear to be pure *S. fragilis*, but the species is described here to assist recognition of hybrids between it and *S. alba*...'

Bold names under Baker (2009) are those considered to be naturalised in Tasmania. Underlined taxa are those that are not fully naturalised in Tasmania. The remainder are taxa that are commonly cultivated in Tasmania and have the potential to become naturalised as they have done in other Australian states.

very few Tasmanian records. Jacobs and Murray (2000) and Carr (1996) are accounts for New South Wales and Victoria respectively and do not discuss any Tasmanian distributions in detail.

Materials and Methods

This paper includes treatments of Tasmanian taxa that commonly grow in habitats such as the banks of watercourses, lake/dam shores and other permanently or seasonally wet areas. At many locations, it is not clear whether the willows have been intentionally planted, and therefore are not naturalised, or whether they have arisen at the location and naturalised without human aid. In other instances, the plants may have been originally planted and subsequently spread so that a mix of cultivated and naturalised plants is present. Descriptions of some taxa that are present in Tasmania as cultivated plants are also included on the basis that they are naturalised in other parts of the world (in particular south-eastern Australia and New Zealand) and have the potential to become naturalised in Tasmania. The naturalised status of treated species is based upon field observations made by the author and, when available, from notes accompanying herbarium specimens.

The definition of 'naturalised' follows Pysek *et al.* (2004). It refers to 'alien plants that sustain self-replacing populations for at least 10 years without direct intervention by people (or in spite of human intervention) by recruitment from seed or ramets (tillers, tubers, bulbs, fragments, etc.) capable of independent growth'.

The study is based mainly on recently collected specimens held in the Tasmanian Herbarium (HO),

material from other Australian Herbaria (CANB, MEL, NSW), exchange material from overseas herbaria, and comments on selected Tasmanian collections by British Salicologist Desmond Meikle. In the cases where Tasmanian material lacked morphological features the descriptions were supplemented using information from Meikle (1984).

Names that have been previously misapplied in the Tasmanian literature are listed where relevant. Whereas some of these are the result of misidentification of specimens that have been redetermined, others are literature references that appear to have not been based on critical examination of Tasmanian specimens.

Tasmanian distributions follow the floristic regions proposed by Orchard (1988). Geographical origins of the plants treated have been determined from various published sources.

The 'first record' indicates the earliest herbarium voucher of a particular taxon. In the case of naturalised taxa it is not always apparent, from the herbarium vouchers, that the specimens were taken from a cultivated or naturalised plant. It may also be speculated that the plants were naturalised well before the date of first collection. First records for taxa known only from cultivation are included for completeness and are not necessarily a good indication of the time the plant was introduced to Tasmania. To accurately determine the date of introduction of each of the taxa is beyond the scope of this paper.

Herbarium abbreviations follow Holmgren *et al.* (1990).

Taxonomy

Salix L., *Sp. pl.* edn 1, 2: 1015 (1753)

A formal description of the genus is given by Argus (1997), Fang *et al.* (1999), Jonsell (2000) and Ohashi (2001) and is not re-iterated here. A comprehensive discussion of the morphological characters of the genus is given by Skvortsov (1999).

The genus *Salix* spans a wide range of forms from low-growing, mat-forming *shrubs* through to large, wide-spreading *trees*. *Leaves* are simple, stipulate and petiolate, usually deciduous and alternate, although opposite to sub-opposite leaves occur in *S. purpurea*. *Flowers* occur in the axils of bracts and are gathered together in dense spikes or racemes commonly referred to as catkins. Willows are usually dioecious but, in some taxa, including *S.* ×*sepulcralis* nothovar. *chrysocoma* and one of the *S. matsudana* × *S. alba* clones, the catkins often include both male and female flowers. The flowers have a greatly reduced perianth consisting of 1–2 nectariferous glands. Staminate flowers consist of one to many stamens (usually two in Tasmanian taxa), with filaments generally free. Pistillate flowers consist of a unilocular superior ovary with the ovaries either sessile or stipitate, each with 2–4, usually bilobed stigmas. The *fruit* is a 2–4-valved capsule that contains numerous seeds. Each *seed* has a tuft of fine silky hairs attached at its base.

Characters that distinguish *Salix* from other Tasmanian plants include the combination of the following characters: deciduous habit (*Salix humboltiana* commonly retains its leaves throughout winter), sympodial growth (plants lack a terminal bud), buds with a single outer scale, flowers borne in catkins and a reduced perianth which consists of 1–2 nectaries.

Leaf characteristics given in this paper are based on mature leaves (material collected in summer and autumn before leaf fall) taken from exposed branches. Foliage from shaded areas of a plant, or that of strong regrowth, is generally of larger dimensions than material collected from unshaded areas.

Both mature leaf material and flowering material may be required to correctly identify some specimens. Mature leaf material (present in summer) and flowering material (present in early spring) occur at different times of the year, thus requiring two collections from the same plant.

Plant habit can be very diagnostic in the identification of willows. The following characters should be noted in the field when sampling: number of stems at or near ground level, size and shape of crown, and branch orientation.

1. *Salix fragilis* L. var. *fragilis*, *Sp. pl. edn* 2. 1: 562 (1762)

Previously misapplied names: S. alba × *S. fragilis* (Curtis 1967), *S. alba*, non-pure *S. fragilis* (Rodd 1982), *S.* ×*rubens* (Carr 1996; Jacobs & Murray 2000; Buchanan 2007).

Common name: Crack Willow

Illustrations: Fig. 1A; 2A; 3

Key to the taxa

1	Leaves linear, lanceolate or oblanceolate, more than three times longer than wide; large trees or shrubs, up to 25 m tall with one to many stems at base of plant; catkins ≤ 13 mm wide	2
1:	Leaves ovate to obovate, less than three times as long as wide; shrubs to small trees, up to 16 m tall, usually with many main stems at base of plant; catkins usually ≥ 20 mm wide (catkins of *S.* ×*calodendron* are <10 mm wide; catkins of *S.* ×*reichardtii* are 10–20 mm wide)	10
2	Trees with fastigiate crown; catkins not seen on mature plants	13. ***S. humboldtiana* 'Pyramidalis'**
2:	Trees or shrubs without fastigiate crown; catkins always produced on mature plants	3
3	Shrubs with opposite to sub-opposite leaves and stems; catkins usually ≤ 20 mm long	12. ***S. purpurea***
3:	Trees with alternate leaves and stems; catkins usually > 20 mm long	4
4	Trees with contorted stems and leaves; catkins female	6. ***S. matsudana* 'Tortuosa'**
4:	Trees without contorted stems and leaves; catkins bisexual, male or female	5
5	Branches strongly pendulous	6
5:	Branches erect to spreading or slightly pendulous	7
6	Stems golden-yellow; catkins bisexual, male or female	5. ***S.* ×*sepulcralis* nothovar. *chrysocoma***
6:	Stems olive-brown to grey-brown; catkins female	4. ***S.* ×*pendulina* var. *pendulina***
7	Branches slightly pendulous	8
7:	Branches erect to spreading	9
8	Stems grey-green to reddish brown; mature leaves glabrous; catkins bisexual, male or female, 15–50 mm long	7. ***S. matsudana* × *S. alba***
8:	Stems golden-yellow; mature leaves with a persistent layer of fine, appressed hairs; catkins female, 60–75 mm long	2. ***S. alba* var. *vitellina***
9	Stems brown to olive-brown; leaves completely glabrous; catkins male; widespread species of rural and urban stream banks	1. ***S. fragilis* var. *fragilis***
9:	Stems orange-yellow, reddish or brown to olive-brown; leaves usually with few persistent hairs; catkins male or female; occasional in both cultivation and resulting from *in situ* hybridisation between *S. fragilis* var. *fragilis* × *S. alba* var. *vitellina*	3. ***S.* ×*rubens***
10	Branches spreading, forming a crown that is usually rounded (i.e. ± as tall as wide)	11
10:	Branches erect, forming a crown that is upright (i.e. taller than wide)	12
11	Leaves lacking rust-coloured hairs	9. ***S. cinerea* subsp. *cinerea***
11:	Leaves with at least some rust-coloured hairs	10. ***S. cinerea* subsp. *oleifolia***
12	Leaf margin strongly recurved, prominently undulate; stipules caducous; catkins male, ovoid	8. ***S.* ×*reichardtii***
12:	Leaf margin narrowly recurved, slightly undulate; stipules persistent; catkins female, cylindrical	11. ***S.* ×*calodendron***

Trees to 25 m tall. *Branches* spreading, forming a rounded crown. *Bark* rough, coarsely fissured, grey. *Stems* thinly pubescent, soon becoming glabrous, brown to olive-brown. *Bud scales* sericeous, soon becoming glabrous, concolorous with the stems. *Stipules* mostly linear, caducous. *Leaves* linear-lanceolate to oblanceolate, sometimes asymmetric, 60–160(–200) mm long, 10–30 mm wide, sericeous, soon becoming glabrous; adaxial surface glossy; abaxial surface glaucous; margin glandular-serrulate; apex acuminate; petiole up to 15 mm long, with several glands at the lamina junction. *Catkins* appearing with the leaves on leafy side-shoots. *Male catkins* 40–60(–80) mm long, 10–13 mm wide, spreading to erect; peduncle up to 12 mm long; bracts

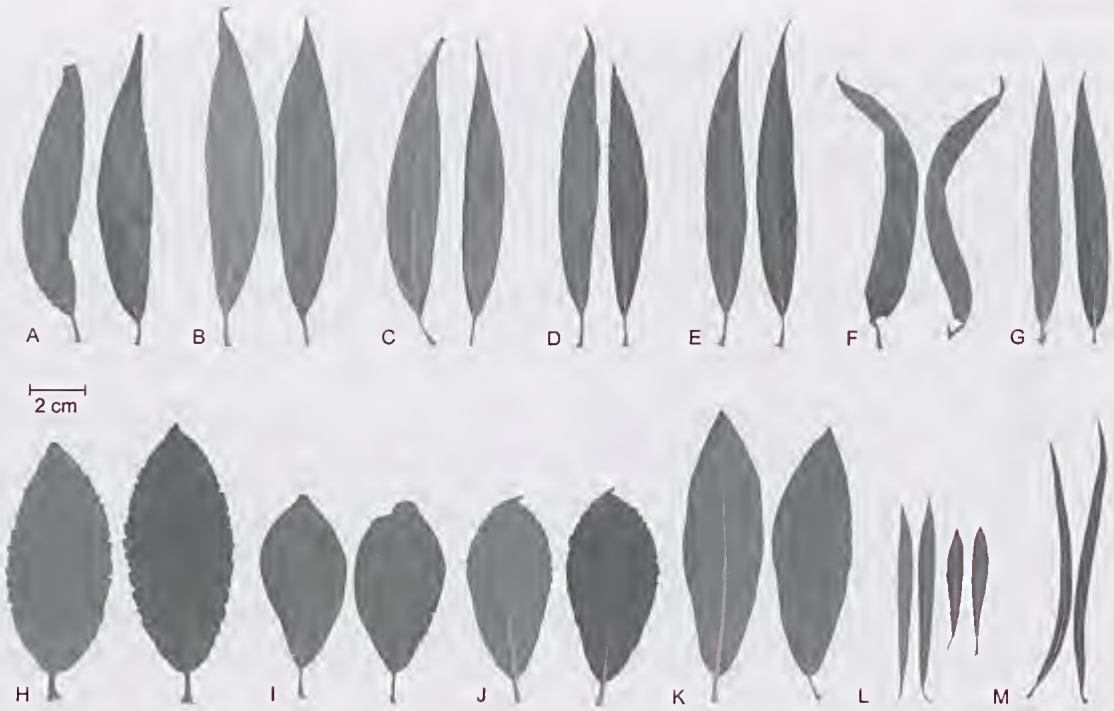

Figure 1. Leaf variation in *Salix* taxa: abaxial (left), adaxial (right). **A)** *S. fragilis* var. *fragilis*; **B)** *S. alba* var. *vitellina*; **C)** *S.* ×*rubens*; **D)** *S. pendulina* var. *pendulina*; **E)** *S.* ×*sepulcralis* nothovar. *chrysacama*; **F)** *S. matsudana* 'Tortuosa'; **G)** *S. matsudana* × *S. alba*; **H)** *S.* ×*reichardtii*; **I)** *S. cinerea* subsp. *cinerea*; **J)** *S. cinerea* subsp. *aleifolia*; **K)** *S.* ×*caladendron*; **L)** *S. purpurea* (showing variation); **M)** *S. humboldtiana* 'Pyramidalis'.

oblong, up to 2 mm long, pale yellow, pilose; stamens 2(–4), exceeding bracts in length, pilose at base. *Female catkins* not seen in Tasmania, but with similar general proportions to male catkins; ovary subsessile, pale green, glabrous. *Seed* not seen.

Discussion: For a comprehensive treatment of *S. fragilis* var. *fragilis*, see Meikle (1984). This species is not treated in Curtis (1967). However, I believe that the hybrid cross, *S. alba* × *S. fragilis* (*S.* ×*rubens*), that is described by Curtis (1967) as '...frequent along river banks and in wet places...' was misapplied to *S. fragilis* var. *fragilis*. *Salix fragilis* was described in Rodd (1982) but it is stated that no Australian specimens appear to be 'pure' *S. fragilis*. In the Tasmanian context, I believe that pure *S. fragilis* is very common. Furthermore, Rodd (1982) cites in his description of *S. alba* a Tasmanian specimen (Hayes, *W.M. Curtis s.n.*, HO) that I believe is *S. fragilis* var. *fragilis*. Subsequent Australian authors (Carr 1996; Jacobs & Murray 2000; Buchanan 2007), in my opinion, at least in part, attribute *S.* ×*rubens* to Tasmania on the basis of the above references and this has perpetuated the misapplication of that name.

Some nomenclatural controversy surrounds *S. fragilis*. Continental European Salicologists regard genuine *S. fragilis* as the wholly glabrous plant with pale clay-coloured twigs and red shoots, which British authors name *S. decipiens* Hoffm. or *S. fragilis* var. *decipiens* (Hoffm.) Koch; they regard what British Salicologists call *S. fragilis* as the hybrid *S. alba* × *S. fragilis*, otherwise known as *S.* ×*rubens* (Ib Christensen & Jonsell 2005; Meikle pers. comm. 2005). The concept of *S. fragilis* accepted in the present account is that of Meikle (1984).

Female catkin and flower characters have been taken from Meikle (1984). In Tasmania, only male *S. fragilis* var. *fragilis* plants are recorded. Carr (1996) and Jacobs and Murray (2000) list female characteristics but state that males are most common in both New South Wales and Victoria. Female plants are considered rare even in areas where *S. fragilis* var. *fragilis* is native (Meikle 1984). This species has stems that readily break

from the parent plant. Several authors (including Sykes 1988; Jacobs & Murray 2000) separate *S. fragilis* var. *fragilis* from other taxa by the fragile nature of the plant, commenting that the stems break with an 'audible crack'. Whilst the stems of *S. fragilis* var. *fragilis* are very brittle this characteristic is variable and can be present in other tree willows. This species can be distinguished from other large upright tree species such as *S. alba* var. *vitellina* and *S.* ×*rubens* by having brown to olive-brown stems as opposed to orange-yellow to reddish stems in *S. alba* var. *vitellina* and *S.* ×*rubens*. In both *S.* ×*rubens* and *S. fragilis* var. *fragilis*, the rootlets immersed in watercourses are red. The leaves of *S. fragilis* var. *fragilis* become completely glabrous whereas the other two taxa usually retain at least some fine appressed hairs. Red-brown leaf galls caused by *Pontiana proxima* (Lepeletier), an exotic willow sawfly, are common on Tasmanian plants. This sawfly is not recorded from mainland Australia (Naumann *et al.* 2002; Finlay & Adair 2006).

The occurrence of tortuose and semi-tortuose saplings, that appear to have arisen from seed, at a site in Huonville, Tasmania (*Baker 1711*, HO), suggests that this species can hybridise with *S. matsudana* 'Tortuosa'; this has also been observed in specimens from Kyneton, Victoria (*Baker 1637*, HO). In Australia and New Zealand, this species has been recorded as hybridising with *S. alba* var. *vitellina* and *S. babylonica* (Sykes 1988; Jacobs & Murray 2000). Hybrids between *S. fragilis* and *S. alba* are discussed in detail under *S.* ×*rubens*. Some *S. fragilis* plants at Launceston (Riverside) consist of male plants with flowers regularly bearing up to four stamens; these plants may be of a different origin to other material in Tasmania. In Victoria, *S. fragilis* var. *furcata* Gaudin, a distinctive variety with bifurcate catkins, is abundantly naturalised at one location in South Gippsland (Carr 1996).

Distribution and habitat: *Salix fragilis* is thought to be native in southern Europe, and has been recorded throughout western Europe from Norway to Spain and Portugal (Meikle 1984). It is naturalised in Australia, New Zealand (Sykes 1988), China (Fang *et al.* 1999), North America (Argus 2007) and South America (Correa 1984). In New Zealand, it is widespread and abundant, and said to be the greatest nuisance of all willows (van Kraayenoord *et al.* 1995). In Australia, it is naturalised in South Australia, New South Wales, Victoria and Tasmania. In New South Wales, it is widespread and abundant (Jacobs & Murray 2000). In Victoria, it has a scattered but locally common distribution mainly through the eastern part of the state and near Geelong and Werribee (Carr 1996). Most Victorian collections are male and almost all populations have arisen vegetatively (Carr 1996). In Tasmania, *Salix fragilis* var. *fragilis* is the most widespread and abundant naturalised willow. It was originally introduced for ornament and as a stream bank stabiliser for de-vegetated watercourses (Cremer *et al.* 1995). It has thrived and spread by human and natural means and today dominates the banks of many watercourses, where it causes many negative impacts (Fig. 3). Vegetative spread is by easily detached stems dispersed on water currents. It is particularly common in the Midlands, North-West and East Coast regions and is also known from the Furneaux, North-East and West Coast regions.

First record: 1944, W.M. Curtis.

Selected specimens examined: **TASMANIA**: Tin Kettle Island, part of Anderson Islands in Franklin Sound, 2.xii.1986, *S. Harris s.n.* (HO); South Arm, 26.ix.1996, *A.M. Buchanan 142B2* (HO); Bay River at Margate, 13.ii.1997, *A.M. Buchanan 14415* (HO); Collinsvale, 15.ii.2000, *A.M. Buchanan 15683* (HO); Birchs Bay, Dales Creek bridge on Channel Highway, 21.x.2003, *M.L. Baker 166* (HO, MEL); Sandy Bay Rivulet at Regent Street, Sandy Bay, 25.ii.2004, *M.L. Baker 3B2* (HO, MEL, herb. D. Meikle); Manning Rivulet at Churchill Avenue overpass, Sandy Bay, 25.ii.2004, *M.L. Baker 3B1* (HO, MEL, herb. D. Meikle); Brumbys Creek on B51, 3 km S of Cressy, 30.x.2003, *M.L. Baker 220* (HO); Cam River mouth, 31.x.2003, *M.L. Baker 241* (HO); Emu River, pumphouse area, Burnie, 31.x.2003, *M.L. Baker 247* (HO); Junction of Cam River and Maldon Creek, 31.x.2003, *M.L. Baker 240* (HO); West Tamar Highway and Atkinsons Road, 31.x.2003, *M.L. Baker 267* (HO); Frankford Road, Rubicon River, 31.x.2003, *M.L. Baker 266* (HO); Distillery Creek, Launceston, 1.xi.2003, *M.L. Baker 2B5* (HO). **VICTORIA**: Barwon River, Fyansford, c. 0.5 km below Buckley Falls, 2.xi.1997, *G.W. Carr 9711-161* (MEL, NSW, CANB); Banks of the Goulburn River at the end of Robert Street, Seymour, 8.xi.1997, *G.W. Carr 9711-182* (MEL, NSW, CANB).

2. *Salix alba* L. var. *vitellina* (L.) Stokes, *Bot. Mat. Med.* 4: 506 (1812)

Common name: Golden Upright Willow

Illustrations: Fig. 1B; 2B

Trees to 15(–25) m tall. *Branches* erect to spreading, often semi-pendulous towards the tips and especially

in the lower crown, forming a rounded crown. *Bark* rough, coarsely fissured, grey-brown. *Stems* appressed pubescent, hairs persistent on leafy stems but sometimes only sparsely so, orange-yellow. *Bud scales* pubescent, becoming glabrous, concolorous with the stems. *Stipules* linear, caducous. *Leaves* lanceolate, 60–145 mm long, 13–30 mm wide, covered in a fine layer of persistent, appressed, silvery hairs; adaxial surface becoming glossy, sometimes remaining sparsely hairy, with hairs remaining on midrib and margins; abaxial surface glaucous, persistently hairy; margin glandular-serrulate; apex acute to acuminate; petiole up to 15 mm long with glands at the lamina junction. *Catkins* appearing with the leaves on leafy side-shoots. *Male catkins* not seen in Tasmania. *Female catkins* 60–75 mm long, up to 8 mm wide, spreading; peduncle up to 8 mm long; bracts lanceolate, up to 4 mm long, pale yellow, hairy, especially on proximal half, caducous; ovary up to 4 mm long, shortly pedicellate, pale green, glabrous. *Seed* not seen.

Discussion: For a comprehensive treatment of *S. alba* var. *vitellina*, see Meikle (1984). This taxon is often treated at different ranks, for example as the cultivar *S. alba* 'Vitellina', as the subsp. *S. alba* subsp. *vitellina* (L.) Arcang. or as a distinct species *S. vitellina* L. In Tasmania, only female *S. alba* var. *vitellina* plants are recorded. This taxon is distinguished from other Tasmanian willows by its large upright habit. It is often semi pendulous towards the ends of the branches, and more so in the lower crown. Its stems are conspicuously orange-yellow, a character that is especially obvious in the autumn and winter months when the tree is without leaves.

Salix alba var. *vitellina* is thought to have hybridised with *S. fragilis* var. *fragilis* at various sites throughout Tasmania, producing plants of intermediate characters that are referable to *S.* ×*rubens*. Hybrids have also been observed in New South Wales and Victoria, most likely with *S.* ×*rubens* and *S. fragilis* var. *fragilis* (Cremer 1995; Carr 1996). A closely related taxon, *S. alba* var. *caerulea* (Sm.) Sm. has been cultivated in Tasmania and is said to have produced viable seed (N. Parker pers. comm. 2005). Timber from *S. alba* var. *caerulea* is used to make cricket bats. A male clone with a distinctive large pyramidal crown is known to be cultivated in Campbell Town and Launceston and possibly at other locations in the state. The plant's identity is unknown, but its bright, orange-yellow stems suggest that it is a cultivar of *S. alba* var. *vitellina* or a hybrid with that taxon as one parent. Other varieties and cultivars are grown as ornamentals throughout the world and some may be cultivated in Tasmania.

Distribution and habitat: *Salix alba* var. *vitellina* is thought to be an ancient selection, originating from central and southern Europe (Skvortsov 1999). It has been cultivated in Europe, possibly since Roman times (Bean 1980) and is now widespread in cultivation or as a relict of cultivation (Skvortsov 1999; Jonsell 2000). It is widely cultivated in the temperate regions of Australia, often on the banks of watercourses, lakes and ponds, and as a specimen tree in large parks and gardens. Carr (1996) and Jacobs and Murray (2000) regard it as naturalised in South Australia, New South Wales, Victoria and Tasmania. On the mainland of Australia, naturalised populations have resulted mainly from vegetative reproduction, producing frequent small populations (Carr 1996). The relatively non-brittle stems have restricted its spread in this manner, as compared to the very brittle stems of *S. fragilis* var. *fragilis*. In Tasmania, *S. alba* var. *vitellina* is one of the most commonly cultivated willows. It is frequently grown as a specimen tree in parks and gardens and on the banks of watercourses and water bodies in rural and urban areas throughout the state. Although Australian authors (Carr 1996; Jacobs & Murray 2000) consider this taxon naturalised in Tasmania, my opinion is that it is not seen in naturalised populations, and that the vast majority of trees were deliberately planted. At one site several small plants were observed growing near a larger, seemingly planted individual (Geilston Bay, *Baker 188*, HO, MEL). The smaller plants may have arisen from vegetative spread. The greatest threat that this taxon poses is through the production of seed and the subsequent invasion of suitable habitats by seedling willows. This may happen in areas where it is sympatric with male willow trees such as *S. fragilis* var. *fragilis*.

First record: 1976, W.M. Curtis.

Selected specimens examined: **TASMANIA:** St Peters Pass (c. 5 km NE of Oatlands), 22.ix.1976, *W.M. Curtis s.n.* (HO); Lower Snug, Channel Hwy, grounds of Channel Historical Museum, 21.x.2003, *M.L. Baker 163* (HO); Campbell Town, 30.x.2003, *M.L. Baker 218* (HO); Riverside, Launceston, 1.xi.2003, *M.L. Baker 281*

(HO); Faggs Gully Creek, Geilston Bay, 17.ii.2004, *M.L. Baker 377* (HO, MEL, herb. D. Meikle); Port Sorell, Port Sorell Road, 1.xii.2004, *M.L. Baker 1189 & M.F. Duretto* (HO); 16.4 km from Bridport on Waterhouse Road. Deep Water property, 11.i.2005, *M.L. Baker 1310 & A.M. Gray* (HO); Westerway, banks of Tyenna River, 16.ii.2005, *M.L. Baker 1591, A. Crane & L. Pope* (HO); Lake Tiberias, Mud Walls Road. 3 km S of Midland Highway, 31.x.2006, *M.L. Baker 1734, A.M. Buchanan & A.M. Gray* (HO). **VICTORIA:** Melbourne, suburb of Brunswick, c. 100 m N of end of Albion Street, 2.x.1994, *G.W. Carr s.n.* (MEL); Forest Creek, 5.x.2005, *M.L. Baker 1639, G. Carr & K. Stewart* (HO).

3. *Salix* ×*rubens* Schrank, *Baier. fl.* 1: 226 (1789)

Illustration: Fig. 1C

Trees to 25 m tall. *Branches* spreading, forming a broad rounded crown. *Bark* rough, coarsely fissured, grey. *Stems* thinly pubescent, soon becoming glabrous, brown to olive-brown or orange-yellow to reddish. *Bud scales* sericeous, soon becoming glabrous, concolorous with the stems or darker. *Stipules* narrow linear, caducous. *Leaves* lanceolate to linear-lanceolate, 90–150(–200) mm long, up to 20 mm wide, sericeous, soon becoming glabrous; adaxial surface glossy to dull green; abaxial surface glaucous, sometimes with a fine layer of appressed hairs; margin glandular-serrate; apex acuminate; petiole up to 18 mm long, with several glands at the lamina junction. *Catkins* appearing with the leaves on leafy side-shoots. *Male catkins* 35–80 mm long, up to 13 mm wide, spreading to erect; peduncle up to 12 mm long; bracts oblong, up to 3 mm long, pale yellow, thinly pilose; glands 2, oblong, up to 1 mm long; stamens 2, exceeding bracts in length, pilose at base. *Female catkins* up to 80(–120) mm long, up to 8 mm wide, spreading, sub-erect to pendulous; bracts oblong, up to 4 mm long, pale yellow to yellow-green, variously hairy; ovary 2–4(–5) mm long, sub-sessile or shortly pedicellate, pale green, glabrous. *Seed* not seen.

Discussion: For a comprehensive treatment of *S.* ×*rubens* see Meikle (1984). *S.* ×*rubens* is a hybrid, the parents being *S. fragilis* and *S. alba*. In Tasmania, *S.* ×*rubens* occurs as at least two different cultivated forms that are not known to be fully naturalised. These are *S.* ×*rubens* nothovar. *basfordiana* (Scaling ex Salter) Meikle f. *basfordiana* Meikle and *S.* ×*rubens* nothovar. *basfordiana* f. *sanguinea* Meikle. In addition to these cultivated plants, there is at least one occurrence of *S.* ×*rubens* that is the result of *in situ* hybridisation. Australian workers, as outlined in Table 1, regard this taxon to be naturalised in Tasmania. However, I believe that the name *S.* ×*rubens* has, in part, been incorrectly applied to the widespread weedy taxon that is treated here as *S. fragilis* var. *fragilis* (see discussion under *S. fragilis* var. *fragilis*).

Salix ×*rubens* may be confused with *S. alba* var. *vitellina* and *S. fragilis* var. *fragilis*. Both *S.* ×*rubens* and *S. fragilis* var. *fragilis* have red rootlets in water. The leaves of *S.* ×*rubens* usually retain some hairs whereas *S. fragilis* var. *fragilis* quickly becomes completely glabrous. *S.* ×*rubens* is present as both sexes and one would expect to find mixed sex populations if they were formed from *in situ* hybridisation.

Distribution and habitat: *Salix* ×*rubens* is common in central Europe as well as in western and temperate Russia and is often associated with non-native habitats (Skvortsov 1999). In New Zealand, *S.* ×*rubens* is common where *S. alba* var. *vitellina* and *S. fragilis* grow together. The plants may be of either sex and backcrossing occurs (Sykes 1988).

In New South Wales, it is considered a very serious environmental weed, and is regenerating by seed (Jacobs & Murray 2000). In Victoria, it is a very widespread and common weed, along stream banks, particularly in the south of the state. In Tasmania, the cultivated forms of *S.* ×*rubens* are uncommon. At Barretta, in the East Coast region a small population (*Baker 159*, HO) of *S.* ×*rubens* nothovar. *basfordiana* f. *basfordiana* was recorded growing in a low lying wet area adjacent to a dam. All plants were female, suggesting the population had resulted from vegetative spread. Deliberate planting in this case could not be ruled out. *Salix* ×*rubens* hybrids that have formed *in situ* are also not common in Tasmania. Young plants thought to be of this hybrid cross have been observed at Westerway, in the East Coast region of the state (*Baker 1535*, HO). *Salix* ×*rubens* may be more widespread in Tasmania due to difficulties in distinguishing it from *S. alba* var. *vitellina* and *S. fragilis* var. *fragilis*.

First record: 2003, M.L. Baker.

Selected specimens examined: **TASMANIA:** Barretta, Kingborough Refuse Centre, 30.iv.2003, *M.L. Baker 106* (HO, MEL); Faggs Gully Creek, Geilston Bay, 17.ii.2004, *M.L. Baker 378* (HO, MEL, herb. D. Meikle); Westerway, banks of Tyenna

River, 16.ii.2005, *M.L. Baker 1535, A. Crane & E. Pope* (HO). **NEW SOUTH WALES:** Numeralla River, 11.x.1995, *S.W.L. Jacobs 7882* (NSW, MEL); University of New England campus, Armidale, 6.x.1997, *G.W. Carr 9710-56, J.R. Hosking, J.J. Bruhl & M. Gardener* (NSW, CANB, MEL, NE).

4. *Salix* ×*pendulina* Wender. var. *pendulina*, *Schriften Ges. Beförd. Gesammten Naturwiss. Marburg* 2: 235 (1831)

Previously misapplied names: Salix babylonica (Curtis 1967; Rodd 1982; Carr 1996; Jacobs & Murray 2000; Buchanan 2007).

Common name: Weeping Willow

Illustrations: Fig. 1C, 2C

Trees to 20 m tall with a wide crown and pendulous branches. *Bark* deeply and coarsely fissured, grey. *Stems* glabrous, olive-brown to grey-brown. *Bud scales* sparsely hairy at first, becoming glabrous, brown. *Stipules* mostly narrow-ovate, glandular-serrate with glands also present on the adaxial surface, caducous. *Leaves* lanceolate, up to 135 mm long, 15–22 mm wide, very sparsely hairy when young, soon becoming glabrous; adaxial surface glossy green; abaxial surface glaucous; margin coarsely glandular-serrate; apex acuminate; petiole up to 12 mm long, with glands near the lamina junction. *Catkins* appearing with the leaves on leafy side-shoots. *Male catkins* not seen in Tasmania. *Female catkins* 15–32 mm long, 5–8 mm wide, spreading to slightly descending or ascending; bracts oblong to narrowly ovate, 1–2 mm long, pale yellow to yellow-green, sparsely hairy on margin; ovary 2-3.5 mm long, shortly pedicellate, pale green, glabrous or very sparsely hairy at the base. *Seed* < 1 mm long.

Discussion: For a comprehensive treatment of *S.* ×*pendulina* var. *pendulina*, see Meikle (1984). Only female plants have been recorded in Tasmania. Both male and female plants have been recorded in New South Wales and Victoria (Carr 1996; Jacobs & Murray 2000). *Salix* ×*pendulina* is a hybrid, the parents being *S. fragilis* var. *fragilis* and *S. babylonica*. It has previously been referred to in Tasmania as *S. babylonica* (Curtis 1967; Rodd 1982; Carr 1996; Jacobs & Murray 2000; Buchanan 2007). However, the name *Salix babylonica* has been misapplied in Tasmania, and it would appear that all non-golden-stemmed weeping tree willows are *S.* ×*pendulina* in this state. Carr (1996) claims that many of the Australian specimens of *S. babylonica* are referable to *S.* ×*pendulina* and *S.* ×*sepulcralis*. The concept of *S.* ×*pendulina* var. *pendulina* accepted in this account is that of Meikle (1984). It is distinguished from the other, strongly-weeping tree willow, *S.* ×*sepulcralis* nothovar. *chrysocoma*, by its stems being olive-brown as opposed to golden-yellow, and by having relatively short catkins composed of only female flowers. *Salix* ×*pendulina* differs from *S. babylonica* by having distinctly pedunculate catkins that are usually greater than 20 mm long. One cultivated specimen with ovaries sparsely hairy at the base has been observed in Tasmania (Warrane, *Baker 211*, HO). These can be referred to as *S.* ×*pendulina* var. *eleganitissima* C.Koch (Meikle 1984). The type variety has completely glabrous ovaries.

Distribution and habitat: Although its origin is unclear, it is thought that *S.* ×*pendulina* is a garden hybrid that originated in Germany early in the 1800s (Meikle 1984). In New Zealand, it is naturalised throughout the country, especially in moist places near still or flowing water (Sykes 1988 as *S. babylonica*). In New Zealand literature, it is treated within *S. babylonica*, as plants are described with catkins up to 30 mm long (New Zealand material not seen). In Victoria, it is widely cultivated for ornament, and naturalised populations grow along streams; it is unknown whether naturalised populations have arisen by vegetative means or by *in situ* hybridisation (Carr 1996). It is also naturalised in New South Wales. Curtis (1967) remarks that this species is commonly planted and is more or less naturalised in Tasmania. Whilst it is commonly cultivated as roadside plantings, in parks and large gardens, and on the banks of watercourses and other water bodies, it has not been recorded as a naturalised species. All individuals appear to have been planted deliberately and are not actively spreading. It has the potential to breed with plants of other male willow taxa.

First record: 1971, W.M. Curtis.

***Specimens examined*: TASMANIA:** Hayes, 4.x.1971, *W.M. Curtis s.n.* (HO, BP); Three Hut Point, Gordon, 21.x.2003, *M.L. Baker 167* (HO); Huonville, Apex Park, 21.x.2003, *M.L. Baker 174* (HO); Southern Outlet, Kingston, 22.x.2003, *M.L. Baker 181* (HO); Faggs Gully Creek, Geilston Bay, 27.x.2003, *M.L. Baker 195* (HO, MEL, herb. D. Meikle); Kangaroo Bay Rivulet, between Rosny Golf Course and Warrane, 29.x.2003, *M.L. Baker 213* (HO,

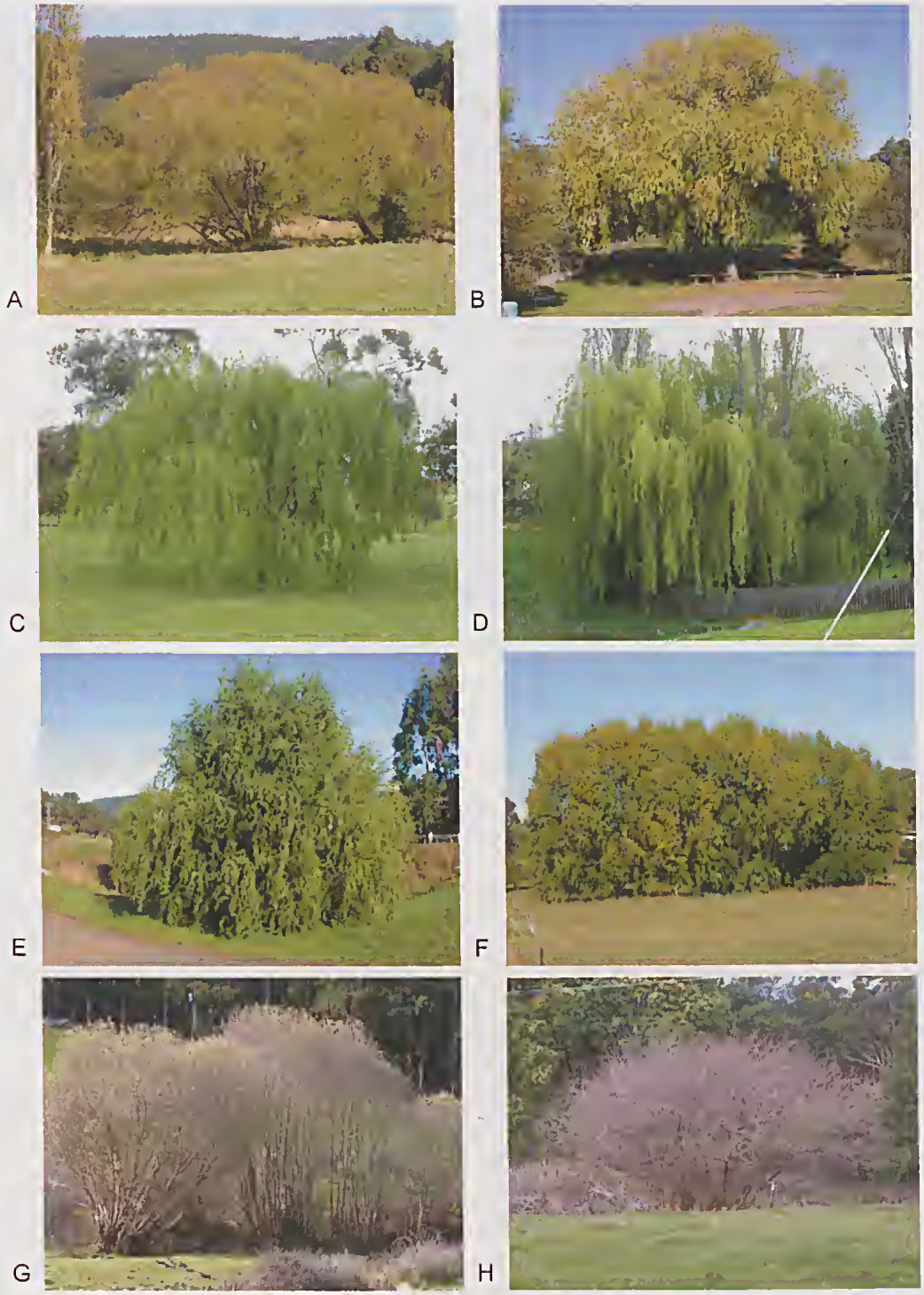

Figure 2. Habit of selected *Salix* taxa. **A)** *S. fragilis* var. *fragilis*; **B)** *S. alba* var. *vitellina*; **C)** *S. pendulina* var. *pendulina*; **D)** *S.* ×*sepulcralis* nothovar. *chrysocoma*; **E)** *S. matsudana* 'Tortuosa'; **F)** *S. matsudana* × *S. alba* (windbreak planting consisting of several trees); **G)** *S.* ×*reichardtii*; **H)** *S. cinerea* subsp. *cinerea*.

Figure 3. *Salix fragilis* var. *frogilis* growing on the floodplains and banks of the South Esk River at Longford.

MEL, herb. D. Meikle); Deloraine Rotary caravan park at Mersey River, 30.x.2003, *M.L. Boker 229* (HO); Campbell Town, Elizabeth River, 30.x.2003, *M.L. Baker 217* (HO); Riverside, Launceston, 1.xi.2003, *M.L. Baker 278* (HO). **NEW SOUTH WALES:** Bango Creek, Yass, 16.x.1980, *R. Coveny 10758 & P. Hind* (HO, NSW); Lachlan River, Cowra, 16.x.1980, *R. Coveny 10744 & P. Hind* (HO, NSW); Flood Creek, Braidwood, 21.x.19B0, *R. Coveny 10832 & P. Hind* (HO, NSW). **VICTORIA:** Burrowye Creek (a tributary of Murray River), 5 km NW of Burrowye Post Office, 17.x.1980, *R.G. Coveny 10784 & P.D. Hind* (HO, NSW, MEL); 100 m SW of Leneva School, 18.x.1980, *R.G. Coveny 10787* (HO, NSW, MEL); Castlemaine, Victoria, Forest Creek, 5.x.2005, *M.L. Boker 1640, G. Corr & K. Stewart* (HO).

5. *Salix* ×*sepulcralis* Simonk. nothovar. *chrysocoma* (Dode) Meikle, *Watsonia* 15(3): 274 (1985)

Common name: Golden Weeping Willow

Illustrations: Fig. 1E; 2D

Trees up to 15(–18) m tall with a wide-spreading crown and pendulous branches. *Bark* deeply fissured, grey to brown. *Stems* golden-yellow, sparsely pubescent, soon becoming glabrous. *Buds* golden to greenish-yellow, pubescent, soon becoming glabrous. *Stipules* small and caducous or absent. *Leaves* lanceolate, 45–110 mm long, up to 20 mm wide, thinly pilose, becoming glabrous, adaxial surface glossy, abaxial surface glaucous; margin irregularly glandular-serrate; apex acuminate; petiole up to 8 mm long, yellow, often with 1 or more glands near the lamina junction. *Catkins* appearing with leaves on short, leafy side shoots, comprised of either solely male flowers, solely female flowers or bisexual, up to 50 mm long, 5–10 mm wide, spreading to erect, commonly curved; bracts lanceolate, c. 2 mm long, yellow, sparsely pubescent. *Stamens* 2, exceeding bracts in length; filaments hairy towards base. *Ovary* 2–3 mm long, green, glabrous, sessile to sub-sessile. *Seed* seen occasionally.

Discussion: For a comprehensive treatment of *S.* ×*sepulcralis* nothovar. *chrysocoma*, see Meikle (1984). Plants are frequently bisexual, with male, female and bisexual catkins occurring on the same tree. The golden weeping willow is one of only two Tasmanian willows that have bisexual catkins (the other being one of the New Zealand-produced *S. matsudana* × *S. alba* clones). *Salix* ×*sepulcralis* nothovar. *chrysocoma* is a hybrid that combines the golden-yellow stems of *S. alba* var. *vitellina* with the strong weeping habit of *S. babylonica*, two characters that distinguish it from all other willows in Tasmania. *Salix alba* var. *vitellina* is somewhat weeping, but it is never as pendulous as *S.* ×*sepulcralis* nothovar. *chrysocoma*. It is said to be far more commonly cultivated in Europe than the true *S. babylonica* (Akeroyd 1993), a taxon thought to be either extremely rare or no longer grown in the British Isles (Meikle 1984) and not recorded correctly in Tasmania.

The type variety (*S.* ×*sepulcralis* var. *sepulcralis*), a less pendulous, olive-stemmed tree, is recorded for New South Wales (Carr 1996; Jacobs & Murray 2000) and Victoria.

Distribution and habitat: *Salix* ×*sepulcralis* nothovar. *chrysocoma* is a very commonly cultivated willow. Its origins are largely unknown, but it was first described from cultivated material grown in Europe (Meikle 1984). In New Zealand, it is widely planted in streambank habitats, grows wild with *S. fragilis* and *S. alba*, and is thought to hybridise with them (Sykes 1988, as *S.* ×*chrysocoma*). In New South Wales, it is widely planted and commonly naturalised (Jacobs & Murray 2000). In Victoria, it is widely planted for ornament and stream stabilisation and is commonly naturalised. Seed is set but the tree typically reproduces by vegetative

Figure 4. Saplings of *S. matsudana* 'Tortuosa' × *S. fragilis* var. *fragilis* at a disturbed site in Huonville. Inset: Close-up of a single sapling showing contorted stem and leaves.

means (Carr 1996). In Tasmania, it is grown as roadside plantings, in parks and large gardens, and is often planted on the banks of watercourses and water bodies in rural areas. It is rarely recorded as naturalised, most plants appear to have been planted deliberately. At one location (Emu River, Burnie *Baker 248*, HO), a small degree of vegetative spread, limited to a few plants, is evident but deliberate planting still cannot be ruled out. This taxon is capable of sexual reproduction, a population of small saplings were growing in a roadside drainage line in southern Tasmania (Lucaston, *Baker 1745*, HO). The plants had characteristic yellow stems of *S.* ×*sepulcralis* nothovar. *chrysocoma*. Both *S. fragilis* var. *fragilis* and *S.* ×*sepulcralis* nothovar. *chrysocoma* were in cultivation nearby. *Salix* ×*sepulcralis* nothovar. *chrysocoma* may have also been a parent of an infestation of plants which grew in sediment settling ponds at Launceston.

First record: 1969, W.M. Curtis.

***Selected specimens examined*: TASMANIA**: Melton Mowbray, 27.ix.1969, *W.M. Curtis s.n.* (HO); Huonville, Apex Park, 21.x.2003, *M.L. Baker 172* (HO); Kingston, along Southern Outlet, 22.x.2003, *M.L. Baker 180* (HO); Kangaroo Bay Rivulet, between Rosny Golf Course and Warrane, 29.x.2003, *M.L. Baker 212* (HO); Campbell Town, Elizabeth River, 30.x.2003, *M.L. Baker 216* (HO); Burnie, Emu River, pumphouse area, 31.x.2003, *M.L. Baker 248* (HO); Penguin, Penguin Creek, 31.x.2003, *M.L. Baker 251* (HO); Launceston, Riverside, 1.xi.2003, *M.L. Baker 271* (HO); Perth (South Esk River), park area near bridge, 1.xi.2003, *M.L. Baker 288* (HO); 4.9 km W of Bridport on the Bridport/George Town road, 12.i.2005, *M.L. Baker 1420 & A.M. Gray* (HO). **VICTORIA**: Melbourne, suburb of Macleod. Borlase Reserve, junction of Lower Plenty Road and Greensborough Road, 29.x.1994, *G.W. Carr s.n.* (MEL).

6. *Salix matsudana* Koidz. 'Tortuosa'

Common names: Tortured Willow, Twisted Willow

Illustrations: Fig. 1F; 2E

Trees 10–15 m tall. *Branches* strongly contorted, forming a rounded crown. *Bark* fissured, grey. *Stems* contorted, slightly pendulous, at first thinly pubescent, soon becoming glabrous, green to dark reddish. *Bud scales* pubescent, soon becoming glabrous. *Stipules* mostly linear, contorted, caducous. *Leaves* lanceolate, 80–130 mm long, 10–25 mm wide, at first pubescent,

soon becoming glabrous or very sparsely hairy, contorted; adaxial surface deep green and lustrous; abaxial surface glaucous; margin glandular-serrulate; apex acuminate; petiole up to 5 mm long without glands. *Catkins* appearing with the leaves. *Male catkins* unknown. *Female catkins* 10–15(–20) mm long, up to 5 mm wide, spreading, curved; peduncle 2–4 mm long; bracts oblong, up to 1.5–2.5 mm long, pale yellow, sparsely hairy; ovary 2–2.5 mm long, sessile, glabrous. *Seed* not seen.

Discussion: For other treatments of *S. matsudana* 'Tortuosa', see Carr (1996) and Jacobs and Murray (2000). In Australia, it is known only as a female plant and bears very short and narrow catkins. *Salix matsudana* 'Tortuosa' can be immediately distinguished from other willows that grow in Tasmania by its strongly contorted branches, stems and leaves. Some authors believe that the species is synonymous with *S. babylonica* (Skvortsov 1999; Jonsell 2000). For consistency with other Australian workers (Carr 1996; Jacobs & Murray 2000), the name *Salix matsudana* 'Tortuosa' has been adopted. This plant is capable of producing viable seed and seedlings through hybridisation with plants of other willow taxa. For example, a small infestation of plants was recorded at Huonville (*Baker 1711*, HO), ranging in size from 3–50 cm tall, growing in a poorly drained, disturbed site of approximately 100 square metres in extent. The plants appeared to have arisen from seed because hand-pulled plants had well-developed tap roots. The plants displayed varying degrees of contortedness, indicating that *S. matsudana* 'Tortuosa' is one of the parents (Fig. 4). The second parent (pollen donor) was most likely *S. fragilis* var. *fragilis*. Both *S. matsudana* 'Tortuosa' and *S. fragilis* var. *fragilis* were growing together in a nearby garden. Such hybrid plants may be more common in Tasmania. Hybrids of this nature have been recorded at Kyneton, Victoria (*Baker 1637*, HO) and New Zealand (Sykes 1988).

Distribution and habitat: The tortured willow was introduced as an ornamental plant from China to Europe in the early 1920s (Bean 1980). It is naturalised in New South Wales (Jacobs & Murray 2000) and in Victoria, where it is widely cultivated and has become sparingly naturalised by vegetative means (Carr 1996). Field observations indicate that whilst this taxon is commonly cultivated throughout Tasmania, it is hardly naturalised. Occasionally individuals or small groups of trees grow around municipal rubbish tips from dumped garden refuse (for example at Rosebery and Queenstown). However, it is never seen in large populations, nor is it seen infesting banks of waterways.

First record: 2003, M.L. Baker.

Selected specimens examined: **TASMANIA:** Rosny Golf Course, 30.iv.2003, *M.L. Baker 104* (HO); Huon Highway, W of Sandfly junction, 12.ix.2003, *A.M. Gray 1275* (HO); Kingston, Southern Outlet, 22.x.2003, *M.L. Baker 179* (HO); Deloraine Rotary Caravan Park, Deloraine, 30.x.2003, *M.L. Baker 230* (HO); Perth (South Esk), park area near bridge, 1.xi.2003, *M.L. Baker 287* (HO); Royal Tasmanian Botanical Gardens, 4.iii.2004, *M.L. Baker 390 & N. Papworth* (HO); Rosebery, waste transfer station, 15.ix.2004, *M.L. Baker 568 & A.M Gray* (HO); Pioneer, 11.i.2005, *M.L. Baker 1363 & A.M. Gray* (HO). **VICTORIA:** Ballarat/Sebastopol, c. 250 m downstream from Prest Street bridge crossing of the Yarrowee River, 19.x.1994, *V. Stajsic 1018* (MEL, NSW, AD); Kyneton, Johnson Court, Post Office Creek, 5.x.2005, *M.L. Baker 1636, G. Carr & K. Stewart* (HO).

7. *Salix matsudana* Koidz. × *Salix alba* L.

Common names: New Zealand Hybrid Willow, Matsudana Hybrid Willow

Illustrations: Fig. 1G; 2F

Trees to 25 m tall. *Branches* upright, forming a narrow-conical crown, sometimes semi-pendulous, especially in lower crown. *Bark* fissured, grey. *Stems* pubescent, soon becoming glabrous, grey-green to reddish brown, moderately brittle. *Bud scales* sericeous, soon becoming glabrous, brown. *Stipules* lanceolate, glandular serrate, caducous. *Leaves* lanceolate, 90–140 mm long, 10–17 mm wide, sericeous, soon becoming glabrous; adaxial surface glossy green, abaxial surface glaucous; margin glandular-serrulate, occasionally entire; apex acute to acuminate; petiole up to 10 mm long, without glands at the lamina junction. *Catkins* appearing with the leaves on leafy side-shoots, composed of either solely male flowers, solely female flowers or mixed male and female flowers. *Male catkins* up to 35 mm long, 7–9 mm wide, spreading to erect; bracts, lanceolate, up to 2.5 mm long, pale yellow, sparsely hairy at the base; stamens 2, exceeding the bracts, pilose near the base. *Female catkins* 15–30 mm long, 5–9 mm wide,

spreading to erect; bracts ovate or lanceolate, 1.5–2 mm long, pale yellow, glabrous or sparsely hairy at the base; ovary shortly pedicellate, pale green, glabrous. *Bisexual catkins* ranging from either predominantly male through to predominantly female, 30–50 mm long; floral characters similar to those of male and female flowers. *Seed* c. 1 mm long.

Discussion: This description includes characters from several different clones that were developed in New Zealand by breeding non-tortuose *S. matsudana* with *S. alba*. There are at least three different clones in Tasmania, with at least one being female, one male and a bisexual clone named *S. matsudana* × *S. alba* 'Cannock'. The *S. matsudana* × *S. alba* clones were developed to produce willows suitable for soil conservation and river bank protection. Plants were selected for traits such as rapid establishment, resistance to diseases, extensive root development, narrow crown form and adaptability to extreme site conditions. Three clones were released in 1975 with a further six in 1980 (van Kraayenoord *et al.* 1995). The clones are: 'Cannock' (bisexual), 'Makara' (female), 'Te Awa' (female), 'Tangoio' (female), 'Hiwinui' (male), 'Adair' (male), 'Wairakei' (male), 'Moutere' (male) and 'Aokautere' (male) (Wilkinson *et al.* undated).

This group of willows can be distinguished from other Tasmanian willows by their narrow upright crowns, usually consisting of a single main stem, a character especially obvious in younger specimens. The twigs are olive-green in colour. The branches are often semi-pendant, especially in the lower crown.

Distribution and habitat: These willows are widely planted throughout south-eastern Australia and have started to spread by seed in some rivers in New South Wales and the Australian Capital Territory (Cremer 1995; Carr 1996; Jacobs & Murray 2000). One of the clones has become naturalised by vegetative means in Victoria (Carr 1996). In Tasmania, they are commonly grown in rural areas as windbreak/fence-line plantings and less often as specimen trees for ornament but no plants are known to be naturalised in this state. However, apparently viable seed has been observed in the fruit of the bisexual clone (N.Parker pers. comm. 2005). Planting female specimens is discouraged (Anon. 2007) and the male clones are said to readily hybridise with *S. babylonica*, *S. matsudana* and *S. alba* (Cremer 1995; Jacobs & Murray 2000; Cremer 2003).

First record: 2002, N. Parker.

Selected specimens examined: **TASMANIA**: 'Leighton' near Western Junction, 31.x.2002, *N. Parker s.n.* (HO); Channel Highway, Margate, fence-line planting opposite Kingborough Bowls Club, 21.x.2003, *M.L. Baker 15B* (HO, MEL, CANB); Huon Highway and Collara Road junction, 22.x.2003, *M.L. Baker 1B2* (HO); Lucaston, Bakers Creek Road, 22.x.2003, *M.L. Baker 1B4* (HO); Elphinstone Road (C516), 30.x.2003, *M.L. Baker 222 & 223* (HO); Mooreville Road and Mount Road junction near Ridgley, 30.x.2003, *M.L. Baker 237* (HO); Tasmanian Arboretum, 30.x.2003, *M.L. Baker 232* (HO); West Tamar Highway, 31.x.2003, *M.L. Baker 26B* (HO); Junction of Forth River and Bass Highway, 31.x.2003, *M.L. Baker 262* (HO). **NEW SOUTH WALES**: Gardners Road, Orange, 9.x.1995, *S.W.L. Jacobs 7B39* (NSW, MEL); Agricultural Research Station, Orange, 9.x.1995, *S.W.L. Jacobs 7B32* (NSW, CANB, MEL). **VICTORIA**: Forest Creek, Castlemaine, 5.x.2005, *M.L. Baker 1641, G. Carr, & K. Stewart* (HO); Harcourt, Barkers Creek, 5.x.2005, *M.L. Baker 163B, G. Carr & K. Stewart* (HO).

8. *Salix* ×*reichardtii* A.Kern., *Verh. K. K. Zool.-Bot. Ges. Wien* 10: 249 (1860)

Previously misapplied names: *S. atrocinerea* Brot. (Curtis 1967), *S. cinerea* (Rodd 1982; Carr 1996; Jacobs & Murray 2000; Buchanan 2007).

Common name: Pussy Willow

Illustrations: Fig. 1H, 2G

Multi-stemmed *shrubs* or small *trees* up to 12(–16) m tall. *Branches* erect, forming a crown that is usually taller than wide. *Bark* usually smooth, developing longitudinal fissures with age. *Stems* densely pubescent when young but becoming glabrous with age, grey when hairy but becoming reddish brown, olive or grey with age. *Bud scales* densely pubescent at first, soon glabrous, concolorous with stems, often reddish. *Stipules* auriculate, up to 5 mm long, irregularly serrate, caducous; serrations gland-tipped. *Leaves* mostly elliptic, sometimes obovate or oblong, 50–120 mm long, 25–55 mm wide; adaxial surface densely pubescent when young, becoming glabrous to sparsely hairy; abaxial surface dull green to glaucous, with hairs persistent; margin revolute, strongly and irregularly undulate-serrate, with teeth usually gland-tipped; apex acute, often twisted obliquely; petiole 6–10(–14) mm long. *Catkins* appearing before the leaves. *Male catkins* 20–30(–50) mm long, 10–20 mm wide, erect; bracts broadly lanceolate to rhomboid, up to 3 mm long, black in upper 1/2–2/3, sericeous; stamens

2, greatly exceeding the bracts. *Female catkins* not seen in Tasmania.

Discussion: For a discussion of *S.* ×*reichardtii* see Meikle (1984). *Salix* ×*reichardtii* is a hybrid, the parents being *S. cinerea* and *S. caprea*. It is unlikely that *S.* ×*reichardtii* appeared in Tasmania as the result of *in situ* hybridisation, and instead, a selection (or selections) would have been introduced into the state. This hybrid is not treated in Curtis (1967). However, I believe that the name *S. atrocinerea*, which is treated by Curtis (1967), was misapplied to *S.* ×*reichardtii*. *Salix atrocinerea* is a synonym of *S. cinerea* subsp. *oleifolia*, and whilst it may have been present in Tasmania at the time of Curtis's publication, it certainly was not represented by any specimens in the Tasmanian Herbarium. Unidentified specimens of *S.* ×*reichardtii* were, however, in the collection at that time. Rodd (1982) cites in his treatment of *S. cinerea* a Tasmanian specimen (Huon Road, near Longley, *Curtis* s.n., HO) that is here referred to *S.* ×*reichardtii*. Subsequent Australian authors (Carr 1996; Jacobs & Murray 2000; Buchanan 2007), in my opinion, have misapplied the name *S. cinerea* to Tasmania on the basis of the above references.

Material upon which the above description is based was sent to British *Salix* specialist Desmond Meikle for his comment, and although he could find *affinities* with *S. cinerea*, *S. caprea* L. and *S.* ×*reichardtii*, he was 'regrettably puzzled' by the specimens (D. Meikle *in litt.*). In this treatment, the plant is referred to as *S.* ×*reichardtii*, and conforms to the descriptions and naming of similar material that occurs in New South Wales, Victoria and New Zealand (New Zealand material not seen).

Salix ×*reichardtii* can be difficult to distinguish from the other naturalised shrub willows in Tasmania. Its narrow and upright habit, in contrast to the rounded habit of *S. cinerea*, is usually a reliable field character. The leaves of *S.* ×*reichardtii* are commonly elliptic as opposed to obovate in *S. cinerea*. The margins of *S.* ×*reichardtii* leaves are markedly more irregular and undulate than those of *S.* ×*calodendron*. The rust-coloured indumentum on the leaves of *S. cinerea* subsp. *oleifolia* is not present on *S.* ×*reichardtii* leaves. Also, *S.* ×*reichardtii* is only known from male plants; female populations would indicate *S.* ×*calodendron* and mixed-sex populations would be the sexually-reproducing *S. cinerea* or perhaps a backcross between *S. cinerea* and *S.* ×*reichardtii*. The wood under peeled bark of *S.* ×*reichardtii*, *S. cinerea* and *S.* ×*calodendron* is variously ridged, and is a good spotting character for all of these taxa.

A complex series of hybrids between *S.* ×*reichardtii* and *S. cinerea* subsp. *cinerea* has been noted in one location in Victoria (Carr 1996). It is possible that this has also occurred in Tasmania, but this is supported only by anecdotal evidence. An ornamental weeping willow, marketed as *S. caprea* 'Weeping Sally', is occasionally cultivated in Tasmania. The pendulous scion, although reported to be *S. caprea*, has-rust coloured indumentum on the leaves, indicating it has *S. cinerea* subsp. *oleifolia* parentage. It may be a hybrid between *S. caprea* and *S. cinerea* subsp. *oleifolia*, or a pendulous/prostrate form of the latter. It is female. The rootstock is *S.* ×*reichardtii*, in the sense described above. It is strongly upright and serves as robust stem to which the weeping scion is grafted. The rootstock is prone to shooting from the base, resulting in the production of flowering stems that are male. The flowering time of the scion and rootstock overlap, are in very close proximity and sexual reproduction results in the production of fertile seed.

Distribution and habitat: *Salix* ×*reichardtii* is native throughout Europe where both of its parents co-occur. In Australia, it is commonly planted as an ornamental and for shelter belts in New South Wales, Victoria and Tasmania, and is naturalised throughout this area on the banks of watercourses, lake shores and in drainage lines (Carr 1996; Cremer 1995; Jacobs & Murray 2000). In Tasmania, *S.* ×*reichardtii* is widely cultivated as an ornamental species in parks and large gardens, and is commonly planted in rural areas as a windbreak species. It is occasionally naturalised in drainage lines in paddocks and roadsides and along watercourses. Dispersal in these situations is by re-sprouting fallen trees and branches, although it is sometimes difficult to determine whether spread has been by natural means or if it has been facilitated by planting. It may serve as a pollen donor if in close proximity to female plants of *S. cinerea*.

First record: 1962, W.M. Curtis.

Selected specimens examined: **TASMANIA:** Huon Road, near Longley (c. 18 km S of Hobart), ix.1962, *W.M. Curtis s.n.* (HO); Harold Gatty Memorial Park, Campbell Town, 30.x.2003,

M.L. Baker 219 (HO); Ulverstone, Bass Highway/Preston Road junction, 31.x.2003, *M.L. Baker 259* (HO); Riverside, Launceston, 1.xi.2003, *M.L. Baker 270* (HO); She Oak Road, 7.iv.2004, *M.L. Baker 409* (HO); Williamsford, 17.iv.2004, *L.H. Cave 282* (HO); Fourteen Mile Road, (C601) c. 1 km from Lyell Hwy., 5.v.2004, *A.M. Gray 1359* (HO); 16.4 km from Bridport on Waterhouse Road, Deep Water property, 11.i.2005, *M.L. Baker 1311 & A.M. Gray* (HO); George Town waste transfer station (tip) off Mt George Road, 12.i.2005, *M.L. Baker 1466 & A.M. Gray* (HO). **NEW SOUTH WALES**: 3 km E of Murrumbateman, 13.xii.1989, *B.J. Lepschi 242* (CANB).

9. *Salix cinerea* L., *Sp. pl.* 2: 1021 (1753) subsp. *cinerea*

Common name: Grey Sallow

Illustration: Fig. 1H; 2H

Multi-stemmed *shrubs* or small *trees* up to 5(–15) m tall. *Branches* erect to spreading, usually forming a rounded crown. *Bark* usually smooth, occasionally with longitudinal fissures. *Stems* densely pubescent when young, grey but soon becoming glabrous and reddish to orange-brown. *Bud scales* densely pubescent at first, soon glabrous, ±concolorous with stems. *Stipules* auriculate, up to 5 mm long, irregularly serrate, caducous; serrations gland-tipped. *Leaves* usually obovate, occasionally elliptic, 20–75 mm long, 10–35 mm wide, with indumentum of translucent uncoloured hairs; adaxial surface densely pubescent when young, becoming glabrous; abaxial surface densely pubescent when young, becoming glabrescent, usually retaining a sparse covering of scattered hairs, dull green; margin finely revolute, slightly to markedly irregularly undulate-serrate, with teeth usually gland-tipped; apex sub-acute, often twisted obliquely; petiole up to 10 mm long. *Catkins* appearing before the leaves. *Male catkins* 16–36 mm long, 18–24 mm wide, erect; bracts obovate, c. 2 mm long, black in upper 2/3, covered in long silvery hairs; stamens 2, greatly exceeding the bracts. *Female catkins* 20–50(–65) mm long, up to 16 mm wide, erect; peduncle up to 5 mm long; bracts obovate, c. 2 mm long, black in upper 1/2 to 1/3, covered in long, silvery hairs; ovary up to 9 mm long, pedicellate, pale green with a covering of silvery hairs. *Seed* c. 1 mm long.

Discussion: For a comprehensive treatment of *S. cinerea* subsp. *cinerea*, see Meikle (1984). The above description conforms with the application of this name in Victoria (Carr 1996). The misapplication of the name *S. cinerea* to *S.* ×*reichardtii* in Tasmania is discussed under the treatment of *S.* ×*reichardtii*. *Salix cinerea* subsp. *cinerea* can be difficult to distinguish from the other naturalised shrub willows in Tasmania. Its rounded habit, in contrast to the more narrow and upright habit of *S.* ×*reichardtii*, is usually a reliable field character. However, the crown shape of *S. cinerea* subsp. *cinerea* varies from rounded when in open situations to more upright when growing in denser infestations or amongst closed vegetation. The leaves of *S. cinerea* are mostly obovate as opposed to the mainly elliptic leaves of *S.* ×*reichardtii* and *S.* ×*calodendron*. *Salix cinerea* subsp. *cinerea* differs from *S. cinerea* subsp. *oleifolia* by lacking rust-coloured indumentum on its leaves. *Salix cinerea* grows in mixed sex populations; populations of only male plants may indicate vegetative reproducing *S.* ×*reichardtii*. As with *S.* ×*reichardtii* and *S.* ×*calodendron*, the wood under peeled bark of, *S. cinerea* is variously ridged, and is a common spotting character for all of these taxa. The female catkins, ovaries and peduncle of *S. cinerea* subsp. *cinerea* lengthen significantly as they mature (catkins lengthen up to 85 mm long). The lengthening is not as prominent in *S. cinerea* subsp. *oleifolia*.

Distribution and habitat: *Salix cinerea* subsp. *cinerea* is native throughout Europe and temperate Asia (Meikle 1984, 1990) where it is one of a few willows that readily invades disturbed habitats such as ditches, forest edges and openings (Skvortsov 1999). It is naturalised in New Zealand (Sykes 1988) and Australia. In New Zealand, it is a widespread weed of wet habitats and is often the dominant species in swamps (Sykes 1988). In Australia, it is naturalised in South Australia, New South Wales, Victoria and Tasmania (Carr 1996; Jacobs & Murray 2000), along the banks of waterways and in seasonally or permanently wet areas such as drainage lines, lake and dam shores, and swamps and bogs.

Naturalised populations are known to be in Tasmania and on the mainland as mixed-sex populations. The main method of regeneration and spread of *S. cinerea* subsp. *cinerea* is via the production of wind and water borne seed. In Tasmania, the species is only known from two locations: in and around Queenstown in the West Coast region and from the Longley-Kingston area, south of Hobart, in the East Coast region. Two plants

have also been recorded growing in Hobart. In these areas, it is abundantly naturalised and widespread, and is the target of an eradication program. Naturalised populations require sufficiently moist habitats at the time the seed is released to successfully establish, and are consequently restricted to moist roadside cuttings, drainage lines, banks of watercourses and dams, and other permanently or seasonally wet areas. In some areas it has become the dominant species infesting large stretches of stream banks.

First record: 1999, A.J. North.

Selected specimens examined: **TASMANIA**: Lynchford, 23.ii.1999, *A.J. North s.n.* (HO); Southern Outlet A6, just east of North West Bay River, iv. 2000, *A.M. Gray 1044* (HO); Electrona, corner of Channel Highway and Pothana Place, 26.ix.2002, *A. Crane s.n.* (HO); Huntingfield, Nautilus Grove, 24.ix.2003, *M.L. Baker 152* (HO, MEL, NSW, CANB, AD, herb. D. Meikle); Sandfly, Southern Outlet, 26.ix.2003, *M.L. Baker 156* (HO, MEL, CANB, AD, herb. D. Meikle); Southern Outlet, Kingston, 100 m N of Leslie Road underpass, 7.iv.2004, *M.L. Baker 410* (HO, herb. D. Meikle); Longley/Sandfly junction 7.iv.2004, *M.L. Baker 406* (HO, herb. D. Meikle); South Queenstown, 50 m E of bridge leading to cemetery, 14.ix.2004, *M.L. Baker 499 & A.M. Gray* (HO); Queenstown, entrance to old tip, Lynchford Road, 16.iv.2004, *M.L. Baker 667 & A.M. Gray* (HO); Lynchford, near Huon Pine timber yard, 16.iv.2004, *M.L. Baker 668 & A.M. Gray* (HO); Queenstown, tramline near cemetery, 18.ii.2005, *M.L. Baker 1536, J. Robin & A. Laird* (HO); Abelia Drive, off Millhouses Road, Longley (25 m NE), 7.xi.2006, *A.M. Gray 1731* (HO). **NEW SOUTH WALES**: Botany Wetlands, Bonnie Doon Golf Course, 31.viii.1995, *S.W.L. Jacobs 7B25* (NSW, MEL). **VICTORIA**: Macedon, Nursery Road at railway underpass, 5.x.2005, *M.L. Baker 1633, G. Carr & K. Stewart* (HO); Castlemaine, Forest Creek, 5.x.2005, *M.L. Baker 1642, G. Carr & K. Stewart* (HO).

10. *Salix cinerea* L. subsp. *oleifolia* (Sm.) Macreight, *Man. Brit. bot.* 212 (1837)

Common name: Rusty Sallow

Illustration: Fig. 1J

Characters same as *S. cinerea* subsp. *cinerea* but *leaves* with an indumentum of translucent, uncoloured hairs and rust-coloured hairs, the latter sometimes only few and scattered. *Catkins* generally smaller in overall dimensions; male catkins 17–20 mm long; female catkins up to 35 mm long. *Seed* up to 2 mm long.

Discussion: For a comprehensive treatment of *S. cinerea* subsp. *oleifolia*, see Meikle (1984). The misapplication of the name *S. atrocinerea* to *S.* ×*reichardtii* in Tasmania is discussed under the treatment of *S.* ×*reichardtii*. Both male and female plants are recorded in Tasmania. The presence of rust-coloured hairs on the leaf lamina allows this taxon to be differentiated from other willows that grow in Tasmania. The female catkins do not lengthen as significantly as they mature as they do in *S. cinerea* subsp. *cinerea*.

Distribution and habitat: *Salix cinerea* subsp. *oleifolia* is native to Europe where it occurs in Britain, Ireland, western France, Spain and Portugal (Meikle 1984). This subspecies is recognised as naturalised in Victoria (Carr 1996; Walsh & Stajsic 2007) where it grows in similar habitats to the type subspecies (Carr 1996). In Tasmania, it is confined to the North-West region. There is a large naturalised population, the target of an eradication program, between Penguin and Ulverstone, occupying similar habitats to those of *S. cinerea* subsp. *cinerea*. It has also been recorded on the banks of the River Leven near Gunns Plains, and near the township of Edith Creek. It is likely to be more widespread than records suggest.

First record: 2003, M.L. Baker.

Selected specimens examined: **TASMANIA**: Bass Highway between Penguin and Ulverstone, 31.x.2003, *M.L. Baker 252* (HO); Bannons Park, Gunns Plains Road at River Leven, 1.xi.2004, *M.L. Baker B1B & M.F. Duretto* (HO, MEL, AD, CANB); C219 between Edith Creek (town) and Nabageena, E side of road, 2.xi.2004, *M.L. Baker 1029 & M.F. Duretto* (HO); Junction of South Road and Allens Road, between Penguin and Ulverstone, 3.xi.2004, *M.L. Baker 1093 & M.F. Duretto* (HO). **NEW SOUTH WALES**: Mannus Creek, 6.8 km SW of Tumbarumba, on road to Jingellic, 17.x.1980, *R. Coveny 107B2 & P. Hind* (CANB, NSW). **VICTORIA**: Morses Creek, Wandiligong, 13.x.1995, *S.W.L. Jacobs 7901* (MEL, NSW).

11. *Salix* ×*calodendron* Wimm., *Salic. eur.* 187 (1866)

Illustration: Fig. 1K.

Multi-stemmed *shrubs* or *trees*, 12–15 m tall. *Branches* erect to spreading, forming a narrow or rounded crown. *Bark* rough, with scattered longitudinal fissures, grey. *Stems* densely pilose, silky to touch, ash-coloured; wood under peeled bark prominently ridged. *Bud scales* densely pubescent, gray-brown. *Stipules* auriculate, large and prominent, especially on new growth,

8–15 mm long, 5–7 mm wide. *Leaves* elliptic to obovate, up to 140 mm long and up to 50 mm wide, pubescent; adaxial surface glossy at first, becoming dull, with a thin covering of persistent hairs; abaxial surface grey, with a dense covering of persistent hairs; margin irregular, indistinctly glandular-serrate; apex acute; petiole stout, up to 10–15 mm long, densely pubescent. *Catkins* appearing before the leaves. *Male catkins* not known. *Female catkins* 35–75 mm long, 8–10 mm wide, erect to sub-erect, sub-sessile to shortly stalked; bracts ovate-rhomboid, up to 2.5 mm long, black in distal 2/3, pilose; ovary up to 3 mm long, shortly pedicellate, densely white-pubescent. *Seed* not produced.

Discussion: For a comprehensive treatment of *S.* ×*calodendron*, see Meikle (1984). *Salix* ×*calodendron* is thought to be a tri-hybrid willow, the parents being *S. caprea*, *S. cinerea* and *S. viminalis* L. It is most likely that it was introduced into Tasmania as a horticultural selection. *Salix* ×*calodendron* can be difficult to distinguish from the other naturalised shrub willows that occur in Tasmania. The leaves of *S.* ×*calodendron* and *S.* ×*reichardtii* are commonly elliptic as opposed to obovate in *S. cinerea*. The margins of *S.* ×*calodendron* leaves are not as markedly irregular and undulate as are those of *S.* × *reichardtii*. *Salix* ×*calodendron* only occurs as female plants; wholly male populations would indicate *S.* ×*reichardtii* and mixed-sex populations would be a sign of the sexually-reproducing *S. cinerea*. The wood under peeled bark of *S.* ×*calodendron*, *S. cinerea* and *S.* ×*reichardtii* is variously ridged, and is a good spotting character for all of these taxa.

Distribution and habitat: *Salix* ×*calodendron* is presumed to be native to the British Isles where it has a scattered distribution. It is cultivated elsewhere in Europe and occasionally escapes from plantings (Akeroyd 1993). In New Zealand, it is widely cultivated and naturalised along the banks of streams and in swamps near original plantings (Sykes 1988). In Australia, it is occasionally grown for ornament and for stabilisation of stream banks in the south-eastern states. It is considered naturalised but uncommon in New South Wales (Jacobs & Murray 2000) and is possibly naturalised in Victoria (Carr 1996). In Tasmania, this willow is known from only two isolated locations. It was first recorded at Longley (*Baker 1771*, HO), in the East Coast region, where several large shrubs/small trees are in cultivation in a permanently wet area, presumably to 'soak' up excess moisture. No obvious active regeneration by vegetative means was observed at this location. The second population grows on derelict land adjacent to the Queen River at Queenstown (*Baker 1728*, HO), in the West Coast region. The plants are confined to a small area and appear to have been planted, perhaps with some minor spread via vegetative means. It is considered to be sterile (Meikle 1984) and should not pose a weed threat through the production of seed.

First record: 2006, M.L. Baker.

Specimens examined: **TASMANIA**: Queenstown, bank of Queen River, 13.ix.2006, *M.L. Baker 1728* (HO); Coombes Road, Longley, 22.xi.2006, *M.L. Baker 1771 & A. Crane* (HO, herb. D. Meikle). **NEW SOUTH WALES**: East Jindabyne, 12.x.1995, *S.W.L. Jacobs 7887* (NSW).

12. *Salix purpurea* L., *Sp.pl.* 2: 1017 (1753)

Common name: **Purple Osier**

Illustration: Fig. 1L

Multi-stemmed *shrubs* to 6(–8) m tall. *Branches* spreading to erect, forming a rounded bush. *Bark* smooth, pale grey. *Stems* glabrous, whitish-grey. *Bud scales* glabrous, dark purple-brown. *Stipules* small, caducous or absent (not seen in Tasmanian material). *Leaves* linear, linear-lanceolate or oblanceolate, 25–85(–100) mm long, 5–30 mm wide, pubescent when young, soon becoming glabrous; adaxial surface green, sub-lustrous; abaxial surface somewhat paler than adaxial surface; mid-rib prominent, yellow; margin entire to sparsely minutely toothed; apex acute; petiole up to 7 mm long but usually quite short, without glands at the lamina junction. *Catkins* appearing before the leaves. *Male catkins* not seen in Tasmania but with similar general proportions to female catkins (see Meikle 1984); stamens 2, filaments and anthers joined, exceeding bracts in length. *Female catkins* 10–20(–30) mm long, 3–4(–7) mm wide, erect to sub-erect, curved; peduncle 2–3 mm long; bracts ovate, up to 1 mm long, dark brown to black, pilose; ovary 1–1.5(–3) mm long, sessile with a dense covering of short, whitish hairs. *Seed* not seen.

Discussion: For a comprehensive treatment of *S. purpurea*, see Meikle (1984). In Tasmania, only female *S. purpurea* plants are recorded. This species

is distinguished from other Tasmanian willows by the combination of its shrubby habit and long, narrow leaves. Other distinctive characteristics include the leaves, stems and catkins often being borne in opposite to sub-opposite pairs. The bark of *S. purpurea*, when peeled away from the wood, is yellow underneath and is very bitter to taste. The stems of this species are tough and flexible and are used for basket making.

Distribution and habitat: *Salix purpurea* has a widespread native distribution throughout Europe, western Asia and northern Africa, growing in wet habitats such as river margins. The species is naturalised in Australia, New Zealand, Canada and the United States of America. In Australia, it is naturalised in New South Wales and Victoria and is represented by several cultivars of both sexes (Cremer 1995; Cremer *et al.* 1995). There it was planted for erosion control on the banks of rivers and roadside batters (Cremer *et al.* 1995; Carr 1996). In New Zealand, it was introduced for soil stabilisation, as well as for basket making (Sykes 1988). In Tasmania, it has been planted occasionally for stream bank stabilisation and for ornament. It is not known whether this species is naturalised in Tasmania or if all plants have been planted. For example, at the Oldina Forest Reserve in the North-West region of the state, approximately 400 m of creek line is dominated by *S. purpurea*. It was originally planted at this site but it is not known how much of the current population was planted. Monitoring would be required to determine if the species is spreading at this and other sites.

First record: 2004, M.L. Baker.

Specimens examined: **TASMANIA**: Royal Tasmanian Botanical Gardens, 4.iii.2004, *M.L. Baker 389 & N. Papworth* (HO); Oldina picnic area/forest reserve, 3.xi.2004, *M.L. Baker 989 & M.F. Duretto* (HO, MEL); just below Winkleigh bridge, ii.2005, *M. Askey-Doron s.n.* (HO). **NEW SOUTH WALES:** Numeralla River, c. 14 km south of Bredbo on Cooma Road, 11.x.1995, *S.W.L. Jacobs 7877* (NSW, MEL). **VICTORIA:** Ovens River, c. 11 km west of Myrtleford, 13.x.1995, *S.W.L. Jacobs 7908 & 7909* (MEL, NSW). **POLAND:** Wieliczka, ATPOL square DF69, 30.viii.2004, *J. Zelozny s.n.* (HO, KRA).

13. *Salix humboldtiana* Willd. 'Pyramidalis'

Previously misapplied name: S. chilensis Molina (Meikle 1990; Carr 1996; Spencer 1997)

Common name: Pencil Willow

Illustration: Fig. 1M

Trees 10–15 m tall. *Branches* very erect, forming a fastigiate crown. *Bark* smooth. *Stems* glabrous or occasionally with a few hairs, dark brown to olive-green, sometimes reddish. *Bud scales* 2, free along inner margin. *Stipules* small, auriculate, glandular-toothed, caducous. *Leaves* at first pubescent, soon becoming glabrous, linear, 50–150 mm long, 5–10 mm wide, glossy green on both surfaces but slightly paler abaxially; margin finely glandular-serrulate; apex acute; petiole 1–1.5 mm long. *Catkins* (not seen on Tasmanian material) appearing with the leaves on short lateral shoots. *Male catkins* 30–100 mm long, 6–10 mm wide, spreading to erect; peduncle up to 12 mm long; bracts ovate, 2–3 mm long, yellow, pilose; stamens 5–8(–14), exceeding bracts in length, pilose in proximal half. *Female catkins* not known in Australia.

Discussion: For a comprehensive description, see Rodriguez *et al.* (1983); flower and catkin characters given above have been taken from this source. This taxon is immediately distinguished from other willows by its very tall and narrow crown. In Tasmania, catkins have never been observed, and plants commonly retain their leaves throughout winter when most other willows are leafless. According to Dorn (1976) and Rodriguez *et al.* (1983), the name *S. chilensis* Molina, used by various authors (including Meikle 1990; Carr 1996; Spencer 1997) and encountered in the nursery industry, has been wrongly applied to this taxon.

Distribution and habitat: *Salix humboldtiana* is native to Central and South America where it grows from Mexico through to Chile. The fastigiate form originates from the Copiapó province, northern Chile (Rodriguez *et al.* 1983). In Australia, *S. humboldtiana* 'Pyramidalis' is a common garden plant, especially in coastal areas of Queensland, New South Wales and Victoria (Carr 1996; Spencer 1997). It is naturalised to a very limited extent in Queensland and New South Wales (Jacobs & Murray 2000; Bostock & Holland 2007). In Tasmania, this taxon is commonly cultivated and has never been recorded outside of cultivation.

First record: 2004, M.L. Baker.

Specimens examined: **TASMANIA:** Royal Tasmanian Botanical Gardens, Hobart, 4.iii.2004, *M.L. Baker 391 & N. Papworth* (HO); Grosvenor Street, Sandy Bay, Hobart, 15.xii.2006, *M.L. Baker 1768 & A.M. Buchanon* (HO).

Additional Taxa Recorded

Additional uncommon *Salix* taxa have been recorded for Tasmania, by the author and from records held by the Royal Tasmanian Botanical Gardens, but as they are entirely restricted to cultivation, they are not treated here. These taxa include: *S. alba* L. var. *caerulea* (Sm.) Sm., *S. gracilistyla* Miq. var. *melanostachys* (Makino) C.K. Schneid., *S. fargesii* Burkill, *S. caprea* L. 'Weeping Sally', *S. petrophila* Rydb., *S. hastata* L. 'Wehrhahnii', *S. helvetica* Vill., *S. lanata* L., *S. myrtilloides* L. 'Pink Tassels', *S. repens* L. var. *argentea* (Sm.) Wimm. & Grab., *S. retusa* L. and *S. serpyllifolia* Scop. No doubt numerous other taxa are in cultivation in Tasmania.

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Resolution of the *Thelymitra variegata* (Orchidaceae) complex of southern Australia and New Zealand

a253190

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Introduction

Thelymitra J.R.Forst. & G.Forst. is a complex genus of orchids consisting of about 100 described species, several described natural hybrids and at least 13 undescribed taxa. It is concentrated in higher rainfall areas of temperate Australia, but a few species occur in tropical north-eastern Australia, about 20 species occur in New Zealand (15 endemic) and a few species occur in Indonesia, New Caledonia, New Guinea and the Philippines.

This is one of a series of papers by the author reviewing the various morphologically distinct groups or complexes within *Thelymitra*. During the course of my studies of the *Thelymitra variegata* (Lindl.) F.Muell. complex it became evident that several undescribed species were present within the group. I take this opportunity to descibe these new species and review the entire complex.

There are a number of morphological features that, in combination, distinguish members of the *T. variegata* complex from all other *Thelymitra* species. The leaf is usually variously auriculate at the base and the blade is usually spirally twisted or at least somewhat curved. The leaf is also pubescent at the base with the hairs mainly on the veins and margins. The flowers usually have strong lustrous colours, often in combinations of pink, red, yellow, mauve or purple. The column has a rudimentary post-anther lobe with an arc of small digitate to globose glands arranged between the bases of the lateral lobes. The lateral lobes are well-developed and prominent, stipitate, suborbicular to narrow-elliptic and smooth to rugulose. The anther has an elongate terminal beak that is essentially an extension of the connective (see Fig. 1). Although six of the eight species in the complex are apparently insect-pollinated, it is interesting to note that no floral odours have ever been attributed to the group. The likely mechanism for pollination is floral mimicry of other wildflowers (A. Brown pers. comm.)

Abstract

The eight currently known taxa in the *Thelymitra variegata* (Lindl.) F.Muell. complex are reviewed and descriptions are presented for each. *Thelymitra pulcherrima* Jeanes, *T. speciosa* Jeanes and *T. uliginosa* Jeanes from southwestern Western Australia are described as new and illustrated. *Thelymitra spiralis* (Lindl.) F.Muell. var. *pulchella* Nicholls is raised to species rank and given the new name *T. maculata* Jeanes as the epithet 'pulchella' is unavailable. The key diagnostic features relating to the size and colour of the perianth, the size, colour and shape of the lateral lobes of the column and leaf characteristics are elucidated. Information on distribution, habitat, pollination biology, flowering time and conservation status is given for all eight taxa. The main distinguishing features of *Thelymitra apiculata* (A.S. George) M.A.Clem. & D.L.Jones, *T. matthewsii* Cheesem., *T. spiralis*, *T. variegata* and the four new species are tabulated. A key is provided to distinguish all eight members of the *T. variegata* complex.

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Taxonomic history

The first two species in the group to be recognised, *Thelymitra variegata* and *T. spiralis* (Lindl.) F.Muell., were described by Lindley (1839–40) as *Macdonaldia variegata* Lindl. and *M. spiralis* Lindl. respectively (see Discussion for notes on *Macdonaldia*). Mueller (1865: pp 97–98) described *T. porphyrosticta* F.Muell. and commented that his new species was similar to *T. variegata* and *T. spiralis* thereby effectively creating these two new combinations. Bentham (1873) recognised only *T. variegata* while reducing *T. spiralis* and *T. porphryosticta* to synonymy. Mueller (1882) followed Bentham's classification. Cheeseman (1911) described *T. matthewsii* Cheesem. from plants found on the North Island of New Zealand and later Rogers (1930), apparently unaware of Cheeseman's species, described *T. daltonii* R.S.Rogers (as *T. D'Altonii*) from Halls Gap in the Grampians, Victoria. Nicholls (1949) created four varieties of *T. spiralis*—*T. spiralis* var. *scoulerae* Nicholls, *T. spiralis* var. *pallida* Nicholls, *T. spiralis* var. *punctata* Nicholls and *T. spiralis* var. *pulchella* Nicholls—all of which, as well as the type variety, are well illustrated in colour in Nicholls (1951). George (1971) recognised all of Nicholls' varieties except var. *pulchella*, which he relegated to synonymy under the type variety. He also relegated *T. porphryosticta* to synonymy under *T. variegata* and recognised *T. matthewsii* as occurring in Western Australia. George (1984) described *T. variegata* var. *apiculata* A.S.George from plants collected between Eneabba and Mogumber north of Perth. Jones (1988) followed George (1971), but in a brief entry in the supplement at the back of the book *T. variegata* var. *apiculata* was raised informally to species rank as *T. apiculata* (A.S.George) M.A.Clem. & D.L.Jones. Following Clements' study of the various type specimens, Clements and Jones in Clements (1989) formally raised *T. variegata* var. *apiculata* to species rank as *T. apiculata*. Otherwise Clements (1989) recognised only *T. matthewsii*, *T. spiralis* var. *spiralis*, *T. spiralis* var. *pulchella* and *T. variegata* as distinct taxa. Hoffman and Brown (1992) recognised only *T. apiculata*, *T. spiralis* and *T. variegata* as occurring in Western Australia, although they do allude to *T. spiralis* var. *pulchella* and the taxon from Western Australia that was equated by George (1971) with *T. matthewsii* as possibly being distinct entities worthy of recognition. Hoffman and Brown (1998) followed their earlier work but also recognised two informal taxa, both as *T.* aff. *variegata*, one from north of Perth, the other from the south coast of Western Australia. Brown *et al.* (2008) recognised and illustrated the seven Western Australian species described in this paper, either by their currently accepted names or the manuscript names ascribed by the current author.

Discussion

Historically there has been significant confusion about the correct application of names and the interpretation of species within the *Thelymitra variegata* complex. At least some of this confusion has persisted to the present day and has revealed itself in the many floras and orchid books published over the years.

Lindley (1839–40) described the first two species in the group as *Macdonaldia variegata* and *M. spiralis* respectively and distinguished these, and several other apparently unrelated species, from *Thelymitra* in having "the anther incumbent, and not parallel with the stigma". The generic name *Macdonaldia* Gunn ex Lindl. was coined by the notable plant collector Ronald Gunn in honour of Mrs Smith née Macdonald an orchid collector from Tasmania. Hooker (1858) reduced *Macdonaldia* to a section within *Thelymitra* differing from his other sections in having the "Column bifid at the apex, its sides not produced into toothed or feathery arms. Anther projecting, generally more or less granular or villous". Mueller (1865, p. 98) did not recognise *Macdonaldia* and created the new combinations *T. variegata* and *T. spiralis*. In the same article, Mueller (1865) described *T. porphyrosticta* from specimens collected by Maxwell near Salt River and Kalgan in Western Australia. Following my examination of the two type specimens at MEL, I have concluded that one (Kalgan River) is referable to *T. variegata* (lectotypified below) the other (Salt River) to *T. spiralis* (rejected syntype). A specimen at Kew (not seen by me) collected by Maxwell at Kalgan River is an isolectotype (George 1971). Bentham (1873) recognised only *T. variegata* while relegating *T. spiralis* (and *T. porphyrosticta*) to synonymy therein. Bentham (1873) recognised *Macdonaldia* as a section within *Thelymitra* and defined it as "Column-wing broadly produced behind the anther, but much shorter than it, and not

Table 1. Taxanamic history af the *T. variegata* camplex shawing the names in *Macdanaldia* and *Thelymitra* used by variaus authars far the eight taxa recagnised in the current treatment

Author	Name used							
Lindley (1839–1840)	*M. variegata*	*M. spiralis*	n/a	n/a	n/a	n/a	n/a	n/a
Lindley (1840)	*M. variegata*	*M. spiralis*	n/a	n/a	n/a	n/a	n/a	n/a
Mueller (1865)	*T. variegata* *T. porphryosticta*	*T. spiralis* *T. parphryasticta*	n/a	n/a	n/a	n/a	n/a	n/a
8entham (1873)	*T. variegata*	*T. variegata*	n/a	n/a	n/a	n/a	n/a	n/a
Mueller (1882)	*T. variegata*	*T. variegata*	n/a	n/a	n/a	n/a	n/a	n/a
Cheeseman (1911)	*T. variegata*	nane	*T. matthewsii*	n/a	n/a	n/a	n/a	n/a
Rogers (1930)	*T. variegata*	*T. spiralis*	*T. D'Altanii*	n/a	n/a	n/a	n/a	n/a
Nicholls (1949), Nicholls (1951) & Nicholls (1969)	*T. variegata*	**T. spiralis var. spiralis* *T. spiralis var. scaulerae* *T. spiralis var. pallida* *T. spiralis var. punctata*	*T. matthewsii*	*T. spiralis var. pulchella*	n/a	n/a	n/a	n/a
George (1971)	*T. variegata*	*T. spiralis var. spiralis* *T. spiralis var. scaulerae* *T. spiralis var. pallida* *T. spiralis var. punctata* *T. spiralis var. pulchella*	*T. matthewsii*	*T. spiralis var. spiralis*	n/a	*T. matthewsii*	n/a	n/a
Hoffman & Brown (1984)	*T. variegata*	*T. spiralis*	nane	none	*T. sp*	*T. matthewsii*	n/a	n/a
George (1984)	*T. variegata var. variegata*	nane	nane	none	*T. variegata var. apiculata*	nane	n/a	n/a
Jones (1988)	*T. variegata*	**T. spiralis var. spiralis* *T. spiralis var. scaulerae* *T. spiralis var. pallida* *T. spiralis var. punctata*	*T. matthewsii*	none	*T. variegata var. apiculata* *T. apiculata*	*T. matthewsii*	n/a	n/a
Clements (1989)	*T. variegata*	*T. spiralis var. spiralis* *T. spiralis var. scaulerae* *T. spiralis var. pallida* *T. spiralis var. punctata*	*T. matthewsii*	*T. spiralis var. pulchella*	*T. apiculata*	*T. matthewsii*	n/a	n/a
Hoffman & 8rown (1992)	*T. variegata*	*T. spiralis* *?T. matthewsii*	nane	**T. spiralis var. pulchella*	*T. apiculata*	*?T. matthewsii*	n/a	n/a
Hoffman & 8rown (1998)	*T. variegata*	*T. spiralis* *?T. matthewsii*	nane	**T. spiralis var. pulchella*	*T. apiculata*	*?T. matthewsii*	*T. aff. variegata*	*T. aff. variegata*
8rown *et al.* (2008)	*T. variegata*	*T. spiralis*	nane	*T. maculata ms*	*T. apiculata*	*T. uliginasa ms*	*T. speciasa ms*	*T. pulcherrima ms*
Jeanes (this paper)	*T. variegata*	*T. spiralis*	*T. matthewsii*	*T. maculata*	*T. apiculata*	*T. uliginasa*	*T. speciasa*	*T. pulcherrima*

*Nat mentianed specifically by this name, but the identity af the taxan is implicit in the cantext.

hood-shaped. Slender flexuose herbs, with the habit of *T. antennifera*". *Thelymitra carnea* R.Br. and *T. flexuosa* Endl. were the only species Bentham included within this section, while he placed *T. variegata* in his section Biaurella along with four apparently unrelated species. Few authors since Bentham have given *Macdonaldia* any formal recognition.

The description of *T. matthewsii* (Cheeseman 1911) brought the number of generally recognised species within the group to three. Apparently Cheeseman believed his new species to be endemic to New Zealand as there is no mention in his article about it occurring in Australia. When Rogers (1930) described *T. daltonii* (as *T. D'Altonii*) from the Grampians in Victoria, he was either unaware of Cheeseman's article (he makes no mention of it in his protologue) or he believed *T. matthewsii* to be a New Zealand endemic and chose to ignore it. Whatever the case may be it soon became evident that the two names were synonymous, as indicated by Nicholls (1949, 1951; 1969). George (1971) alluded to the presence of *T. matthewsii* in Western Australia based on plants discovered to the east of Perth and illustrated later in Hoffman and Brown (1984). My study of these plants and others from several localities in the Albany area has shown them to be of an undescribed species distinct from *T. matthewsii* (see *T. uliginosa* Jeanes below).

Nicholls (1949) described and illustrated four new varieties of *T. spiralis* – var. *scoulerae*, var. *pallida*, var. *punctata* and var. *pulchella* – the first three based on plants collected by Mrs E. Scouler at Yarloop, the last from plants collected near Bolgart by Mrs R. Erickson, all from Western Australia. George (1971) and Clements (1989) differed in their interpretation of the holotype of *T. spiralis* hence their interpretation of Nicholls' varieties also differed. The former interpreted the type of *T. spiralis* as being the same taxon as Nicholls' var. *pulchella* and hence relegated that variety to synonymy, while maintaining Nicholls' other three varieties as distinct. Clements (1989) interpreted the type of *T. spiralis* as being distinct from Nicholls' var. *pulchella* but rather similar to the other three varieties of Nicholls, which he consequently did not recognise as distinct taxa. In this matter my interpretation of the types follows that of Clements. In fact Nicholls' var. *pulchella* is so distinctive (and different from *T. spiralis*) that I believe it warrants recognition at species rank. The epithet 'pulchella' is, however, unavailable at species rank due to the presence of *T. pulchella* Hook. f. from New Zealand so a new name had to be coined (see *T. maculata* Jeanes below).

George (1984) described *T. variegata* var. *apiculata* from plants collected near Badgingarra homestead north of Perth. These differed from the type variety primarily in the presence of apiculate lateral lobes on the column and the less obviously spiralled leaf blade. The distinctiveness of this taxon was so significant that it was soon raised to species rank (Clements 1989) as *T. apiculata*.

Hoffman and Brown (1998) illustrated and informally described two apparently distinct taxa related closely to *T. variegata*, both as *T.* aff. *variegata*. My own research has shown these two allopatric taxa to be sufficiently distinct morphologically, ecologically and by flower colour to warrant recognition at species rank (see *T. speciosa* Jeanes and *T. pulcherrima* Jeanes below).

Szlachetko (1995) recognised *Macdonaldia* as a genus distinct from *Thelymitra* based on differences in the column structure. He recognised 13 species in *Macdonaldia*, and created nine new combinations (one of which, *M. venosa* (R.Br.) Szlach., was superfluous), but failed to list all the species belonging to that genus according to his concepts. Szlachetko and Rutkowski (2000) again recognised *Macdonaldia* as distinct from *Thelymitra*, but did not list the species belonging to either genus according to their concepts. It is clear from their generic key that some species, traditionally regarded as belonging to *Thelymitra*, have characteristics of both their *Macdonaldia* and *Thelymitra* and it would be difficult to place these species satisfactorily in either genus. The classification of Szlachetko and Rutkowski has not been taken up by later workers on the group including the current author. All the definitions of *Macdonaldia* by the various authors over the years, whether at generic or sub-generic level, have varied considerably. Significantly, the type species of *Macdonaldia* was designated by Clements (1989) as *M. smithiana* Gunn ex Lindl. (=*T. flexuosa*), a species not belonging to the *T. variegata* complex. Preliminary phylogenetic studies of *Thelymitra* based on ribosomal DNA confirm that *Macdonaldia* is paraphyletic and that all its elements are embedded within *Thelymitra*,

and that species in the *T. variegata* complex form a separate clade embedded deeply within the genus. (M. Clements pers. comm.)

Explanation of the terminology used

The genus *Thelymitra* is unusual in the Orchidaceae in that the six perianth segments generally differ very little from each other in terms of size, shape and ornamentation. The labellum does not bear any hairs, calli, glands, ridges, lobes, teeth or fringes and is apparently not involved in pollination. Since the perianth is virtually actinomorphic and generally lacks characters by which to distinguish the species, traditionally the structure of the column has supplied most of these distinguishing characters. Over the years a terminology has evolved to describe the column structure in *Thelymitra*, but some of these terms are poorly understood and some have never been defined adequately. Below is an explanation of some of the terms commonly used in this paper; most have a traditional usage, although this has often not been well understood.

Column (gynostemium): The column is exposed in the centre of the flower, it lacks a free filament and style, is short and thick and broadly winged from below the stigma to the level of the anther or beyond. The apex is usually 3–5-lobed and is often ornamented with trichomes, fringes, teeth, calli, glands, tubercles or lobes. In members of the *T. variegata* complex the apex of the column has a pair of prominent suborbicular to elliptic lateral lobes and a rudimentary post-anther lobe.

Post-anther lobe (mid-lobe): This structure lies beyond the point of insertion of the anther and of the lateral lobes, and it is usually of a different colour to the rest of the column. It has a complex vascular supply always associated with that of the functional anther and may be regarded as an outgrowth of the filament. In some species it is represented only by a short flap or a band of small glands crowded across the back of the anther. In most species it extends well beyond the anther with a free margin that may be plain, undulate, toothed, notched or variously ornamented with tubercles. At its maximum development it forms a fleshy, tubular hood that is variously open on the ventral side and overhangs and obscures the anther. In the *T. variegata* complex the post-anther lobe is rudimentary, extending only a short distance beyond the point of insertion of the anther, with an arc of small ovoid to digitate glands on the dorsal surface.

Lateral lobes (column-arms or lateral staminodes): These two structures lie one on each side of the post-anther lobe and extend forward or upward and often converge. They are each supplied by a single unbranched vascular bundle and are thought to represent staminodes. They may be flat and ribbon-like, terete and finger-like, straight, curved, twisted spirally or bent sharply, and are usually ornamented with lobes, teeth, tubercles or trichomes. The lateral lobes are suborbicular to elliptic in members of the *T. variegata* complex, are more or less straight, parallel or divergent and point in the same general direction as the body of the column or slightly forward.

Auxiliary lobes (accessory lobes or side lobules): Several species of *Thelymitra* have a pair of distinct lobes between the post-anther lobe and the lateral lobes. These have no vascular strand and are most accurately described as being part of a tripartite post-anther lobe. They tend to be fleshy with irregularly jagged margins and sometimes have small surface tubercles. In the *T. variegata* complex the auxiliary lobes are completely absent.

Anther: In *Thelymitra*, the anther is usually small, ovoid, and situated entirely between the column wings. The connective extends beyond the pollinia into an apical beak-like projection of varying size. The anther may be entirely above the stigma or variously obscured behind it. In the *T. variegata* complex the anther is usually inserted near the apex of the column, the pollinia usually held mostly above the stigma. The anther beak is very well developed, usually being about as long as the pollinia, is fleshy and more or less straight or slightly curved forward when seen in profile.

Pollinia: Members of the genus *Thelymitra* possess four pollinia in two groups of two. In the *T. variegata* complex the pollinia are usually tightly bound with the pollinarium being removed by insects as a single unit. However, autogamy has been noted in *T. matthewsii* and is believed to occur in *T. uliginosa*.

Stigma: The stigma in *Thelymitra* is more or less bi-lobed at the apex, usually quadrate or transverse-elliptic in shape and located at the base of the column on a thick stalk.

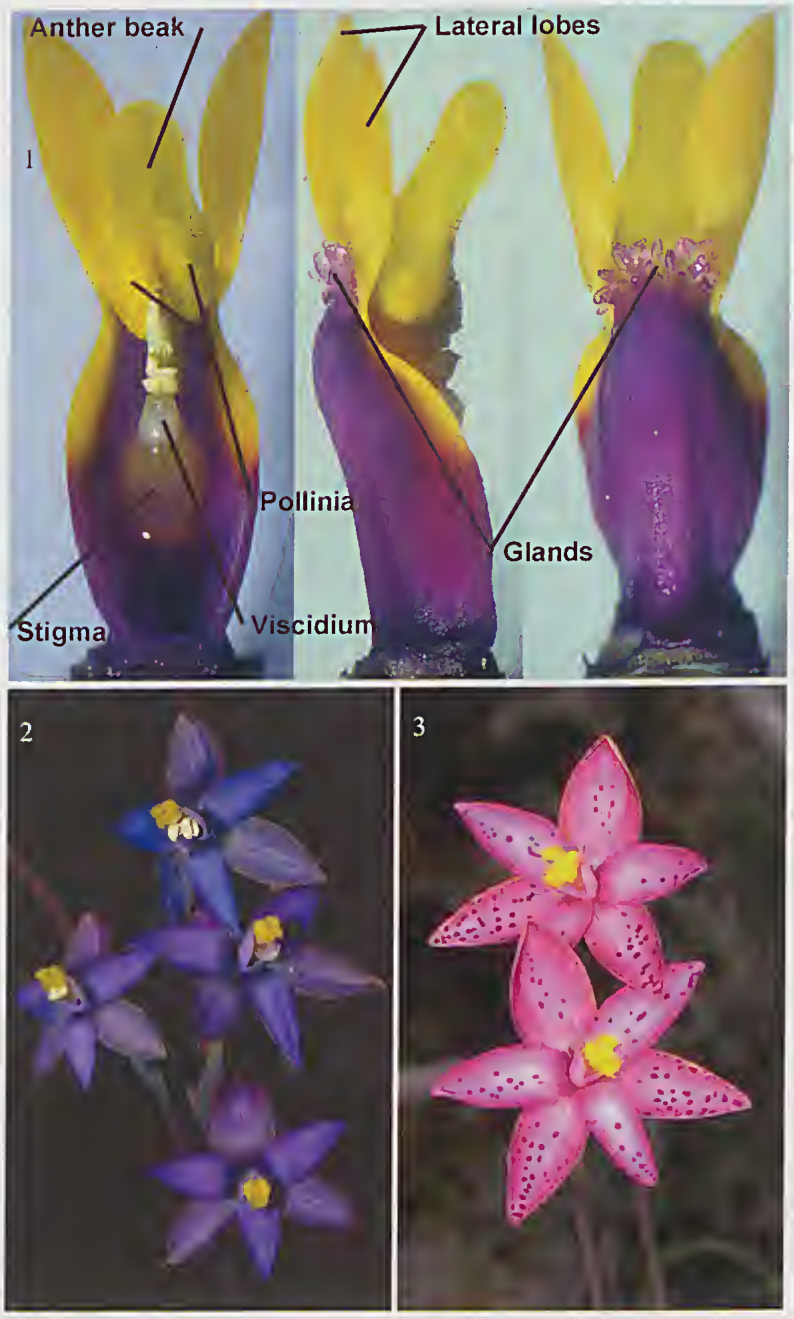

Figure 1-3. 1. Column features of *Thelymitra variegata*. From left to right: ventral, lateral and dorsal views (photographs by Jeff Jeanes); **2.** *Thelymitra spiralis* (photograph by Ron Heberle); **3.** *Thelymitra maculata* (photograph by Viv Holly).

Table 2. Various features of species in the *T. variegata* complex.

	T. spiralis	*T. maculata*	*T. uliginosa*	*T. matthewsii*	*T. apiculata*	*T. variegata*	*T. speciosa*	*T. pulcherrima*
Leaf base shape	ovate-auriculate	ovate	ovate-auriculate	ovate-auriculate	ovate	ovate-auriculate	ovate-auriculate	ovate-auriculate
Leaf blade orientation	spirally twisted	curved to slightly spiralled	spirally twisted	spirally twisted	curved	curved to slightly spiralled	spirally twisted	almost straight to slightly spiralled
Usual flower number	1–3	1	1 or 2	1	2–6	1–6	1	1–6
Sepal length (mm)	8–20(–26)	8–18(–25)	6–15	6–10(–13)	9–20	(10–)14–27	10–25	10–18
Sepal and petal colour and patterning	similar	dissimilar	similar	contrasting	similar	similar	similar	contrasting
Length of lateral lobes of column (mm)	1.5–2.8	1.8–2.8	1.5–2.5	1.5–2	3–4.5	3–5	3–5.5	4–5.5
Shape of lateral lobes of column	ovate to elliptic	suborbicular to elliptic	ovate to elliptic	ovate to elliptic	oblong to elliptic	oblong to elliptic	oblong to elliptic	oblong to elliptic
Length of glands on post-anther lobe of column (mm)	0.2–0.6	0.2–0.6	0.2–0.4	0–0.2	0.1–0.7	0.4–1	0.4–0.7	0.4–1
Length of anther beak (mm)	0.5–1.5	0.8–1.5	0.8–1.5	0.4–0.8	2–4	1.8–2.7	2–3	2–3
Probable pollination biology	entomophilous	entomophilous	facultatively autogamous	facultatively autogamous	entomophilous	entomophilous	entomophilous	entomophilous
Flowering time	Jul.–Oct.	Jul.–5ep.	Jul.–Oct.	Aug.–Oct.	Jun.–Jul.	Aug.–Oct.	Jul.–5ep.	Jun.–Aug.
Preferred substrates	moist sandy clay soils	dry granite or laterite sandy loams	moist sandy clay soils	well-drained sandy and clay loams	shallow sandy soil on laterite	deep sandy soils	heavy clay loams that are wet in winter	lateritic or rarely sandy soils

Key to the known members of the *T. variegata* complex.

1 Lateral lobes of column <3 mm long; anther connective produced into a beak to 1.5 mm long 2
1: Lateral lobes of column 3–6 mm long; anther connective produced into a beak usually >1.5 mm long 5

2 Perianth segments mostly to 12 mm long, rarely to 15 mm long, unspotted 3
2: Perianth segments mostly >12 mm long, often spotted 4

3 Flower solitary, very rarely 2, deep purplish, strongly striated; petals and sepals usually to 10 mm long, of contrasting colour; dry open forests; South Australia, Victoria and New Zealand ..... **4. *T. matthewsii***
3: Flowers 1 or 2, pink, mauve or pale purplish, not strongly striated; petals and sepals often more than 10 mm long, of similar colour; swamp margins; Western Australia ..... **3. *T. uliginosa***

4 Flower usually solitary, pink; sepals and sometimes also the petals, heavily spotted and blotched dark pink or purplish in longitudinal lines; leaf-base not strongly auriculate, lamina often curved but not tightly spiralled; lateral lobes often suborbicular, orange or yellow; dry inland habitats ..... **2. *T. maculata***
4: Flowers 1–3, colour not as above; leaf-base strongly auriculate, lamina usually tightly spiralled; lateral lobes usually elliptic, yellow; more mesic near-coastal habitats ..... **1. *T. spiralis***

5 Lateral lobes of column with a terminal needle-like point; leaf-base not strongly auriculate, lamina curved, not tightly spiralled ..... **5. *T. apiculata***
5: Lateral lobes of column lacking a terminal needle-like point; leaf-base strongly auriculate, lamina tightly spiralled or not 6

6 Flower usually solitary, rarely 2; perianth segments predominantly purplish, with broad, deep reddish gold edges and yellowish margins; found in heavy clay-loam soils ..... **7. *T. speciosa***
6: Flowers 1–6; perianth segments not coloured as above; found in lateritic soil or deep sand 7

7 Perianth segments mostly to 18 mm long, of contrasting colour; sepals predominantly reddish brown with yellow margins; petals predominantly purplish; found in lateritic soil; flowers June to early August ..... **8. *T. pulcherrima***
7: Perianth segments mostly >18 mm long, more or less of similar colour, predominantly reddish, purplish or violet, variegated, mostly with darker spots or blotches, often with yellow margins; found in deep sand; flowers August to early October ..... **6. *T. variegata***

Materials and methods

This paper is the result of a qualitative and quantitative study of the pertinent type material (or photographic reproductions thereof), hundreds of herbarium specimens (both dry and spirit-preserved) from AD, BM, BRI, CANB, E, HO, MEL, NSW, P, PERTH, QRS, SUNIV and WELT, and numerous freshly collected specimens, all of which were vouchered and deposited at the relevant herbaria. Orchid taxa in general, and *Thelymitra* taxa in particular, are much more readily identified from fresh living material where characters of the perianth, the column, flower colour and fragrance are still intact. Familiarity with the taxa gained from field study and the study of freshly collected specimens sent to me by field operatives has made the identification of dried and spirit-preserved herbarium material (including type specimens) much easier.

When collecting *Thelymitra* for study it is essential that the entire above ground parts of the plant be taken, with the majority of the material being preserved in spirit. Plants preserved in the pressed state are often difficult to identify to species level in the absence of additional information. Spirit-preserved specimens, on the other hand, are generally much more easily identified to species level. The observation of plants growing *in-situ* is the ideal method of study for *Thelymitra* in general, and often it is only by this method that cryptic new species can be identified. For this reason the importance of field work in the study of species complexes within *Thelymitra* cannot be overstated and should form an integral part of

any future studies of the group. It is possible that other taxa worthy of recognition exist within this complex, but adequate information and collections of these are lacking at present.

Taxonomy

1. *Thelymitra spiralis* (Lindl.) F.Muell., *Fragm.* 5: 98 (1865)

Macdonaldia spiralis Lindl., *Edwards's Bot. Reg.* appendix to vols 1–23 [*Sketch Veg. Swan R.*]: 50 (1839–40). ***Type***: Swan River, 1839, *J. Drummond s.n.* (holotype K-LINDL!, isotype BM!).

Thelymitra porphyrosticta F.Muell., *Fragm.* 5: 97–8 (1865) *p.p.* not as to type (see under *T. variegata*).

Thelymitra spiralis (Lindl.) F.Muell. var. *pallida* Nicholls, *Victorian Naturalist* 66: 55 (1949). *Type*: Yarloop, c. 1946, *E. Scouler s.n.* (holotype MEL!).

Thelymitra spiralis (Lindl.) F.Muell. var. *punctata* Nicholls, *Victorian Naturalist* 66: 55 (1949). *Type*: Yarloop, c. 1946, *E. Scouler s.n.* (holotype MEL, not found).

Thelymitra spiralis (Lindl.) F.Muell. var. *scoulerae* Nicholls, *Victorian Naturalist* 66: 55 (1949). *Type*: Yarloop, ix.–x.1946, *E. Scouler s.n.* (holotype MEL!).

Illustrations: Fitzgerald (1891) 2: 4 (as *T. variegata*); Nicholls (1951) plate 45, all except figs c & g; Nicholls (1969) plate 47, all except figs c & g; Jones (1988) page 304; Hoffman and Brown (1984) page 42; Hoffman and Brown (1992) page 253; Hoffman and Brown (1998) page 253; Heberle (2000) page 288; Jones (2006) page 254; Brown *et al.* (2008) page 321.

Virtually glabrous terrestrial *herb*. *Tubers* ovoid, 1–3 cm long, 4–10 mm wide, fleshy. *Leaf* ovate-auriculate at base, narrowing abruptly and linear above, 5–10 cm long, 4–10 mm wide, usually spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins often lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 12–30(–45) cm tall, more or less straight. *Scape* 0.6–2 mm diam., wiry, green or purplish. *Sterile bract* solitary, lanceolate to ovate, 15–55 mm long, 3–9 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate to obovate, 6–22 mm long, 3–7 mm wide, green or purplish, sheathing the pedicels, margins connate at base, apex acute to acuminate. *Pedicels* 7–22 mm long, slender. *Ovary* narrow-obovoid, 5–15 mm long, 1.5–4 mm wide. *Flowers* 1–2(–3), 21–40(–50) mm diameter, pink, reddish, purplish or blue, sometimes with darker spots or longitudinal veins, opening freely in warm weather. *Perianth segments* 8–20(–26) mm long, 2–10 mm wide, concave to almost flat, stiffly spreading, often shortly apiculate; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments; *lateral sepals* ovate-lanceolate to lanceolate, slightly asymmetric, acute to acuminate; *petals* ovate-lanceolate to lanceolate, slightly asymmetric, acute to acuminate; *labellum* lanceolate to linear-lanceolate, acute to acuminate, smaller than other segments. *Column* erect from the end of ovary, 4.5–7 mm long, 2.5–3.5 mm wide, broadly winged, similarly coloured to perianth; *post-anther lobe* vestigial, apical margin covered with an arc of digitate to globose glands 0.2–0.6 mm long; *auxiliary lobes* absent; *lateral lobes* more or less parallel, ovate or elliptic, 1.5–2.8 mm long, 0.8–1.6 mm wide, erect or obliquely erect, stipitate, fleshy, rugulose, yellow. *Anther* inserted at apex of column, obloid, 2.4–3.7 mm long, 1.5–2.5 mm wide, projecting forward at about 90° to column, yellow, the connective produced into a fleshy beak 0.5–1.5 mm long, dorsal surface pubescent, ventral surface channelled; *pollinarium* 1.5–2.5 mm long; *viscidium* elliptic, c. 0.7 mm long, c. 0.5 mm wide; *pollinia* coherent, cream. *Stigma* situated c. midway along column, orbicular to transversely broad-elliptic, c. 2.5 mm long, c. 2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–20 mm long, 4–8 mm wide, erect, ribbed. (Fig. 2, Fig. 10 a–c)

Selected specimens examined: **WESTERN AUSTRALIA**: Kelmscott, 15.ix.1924, *G. Coghill s.n.* (MEL 2016031); Armadale, 22.ix.1946, *W.H. Nicholls s.n.* (MEL 643870); Two People Bay–Nanarup, 14.viii.1963, *R. Oliver s.n.* (PERTH 276723); 6 miles N of Porongurups, on Stirling Rd, 14.viii.1958, *A.S. George s.n.* (PERTH 277185); NW slopes of Mt Manypeaks, 11.viii.1986, *G.J. Keighery 9660* (PERTH 855162); Kenwick, 1919, *A.H. Mann s.n.* (PERTH 306541); Cannington, 3.x.1900, *A. Purdie s.n.* (PERTH 276758); Swamp at Cannington, 14.ix.1920, *G.N.O. s.n.* (PERTH 672343); Serpentine, 23.ix.1904, *A. Purdie s.n.* (PERTH 294985); North Dwellingup, peaty flats W of Railway Station, x.1932, *B.T. Goadby s.n.* (PERTH 276790); Albany, 8.viii.1963, *R. Oliver s.n.* (PERTH 276774); West Walpole, opposite Jarrah Road, 21.x.1993, *D.L. Jones 12459* (CANB 9710428); E of Alexandra

Bridge, over Blackwood River, on Brockman Highway, 21.x.1975, *D.F. Blaxell W75/206 & A.S. George* (NSW 462466).

Distribution and habitat: Endemic to southwestern Western Australia, from just north of Perth to Israelite Bay, generally within about 100 km of the coast, with isolated northern populations in the Geraldton to Kalbarri region. Grows mostly in and around seasonal swamps in moist sandy clay soils. Altitude: 10–300 m.

Conservation status: Uncommon to rare, but extremely widespread and well conserved. Suggest 3RC by criteria of Briggs and Leigh (1996) and Near Threatened (NT) by criteria of IUCN (2001).

Flowering period: July to October, but mostly August and September.

Pollination biology: The large, freely opening flowers, functional viscidium, coherent pollen and sporadic production of seed capsules would indicate that this species is probably entomophilous.

Notes: *Thelymitra spiralis* is extremely variable, particularly in terms of flower size and colour and degree of spotting and veining of the perianth. It is most closely related to *T. maculata* but the latter usually has a single, generally smaller flower that is strongly spotted, particularly on the sepals, somewhat deflexed petals and lateral sepals, a narrower column often with suborbicular, orange lateral lobes, a less spirally twisted leaf that is barely auriculate at the base and a preference for drier inland habitats. *Thelymitra spiralis* is also related to *T. matthewsii* and *T. uliginosa*, but the latter two species have generally smaller flowers that are non-spotted and are self-pollinated.

Four varieties of *T. spiralis* have been described (Nicholls 1949). The var. *pallida* only differs from typical plants in having pale flowers, the var. *punctata* in having highly spotted flowers and the var. *scoulerae* in having larger, brightly coloured flowers with broad, somewhat flaccid perianth segments. These three varieties were later reduced to synonymy (Clements 1989) as they show no great departure in floral morphology from typical plants and are not distinct ecologically. The var. *pulchella* is ecologically and morphologically distinct from *T. spiralis*, and hence was recognised by Clements (1989) as a variety of *T. spiralis* and is herein raised to species rank as *T. maculata* (see below).

2. *Thelymitra maculata* Jeanes *nom. et stat. nov.*

Basionym: *Thelymitra spiralis* (Lindl.) F. Muell. var. *pulchella* Nicholls, *Vict. Naturalist* 66: 56 (1949). ***Type***: Open plains or sand covered gravel, near Bolgart, 18.viii.1934, *R. Erickson s.n.* (lectotype QRS 044565! *hic designatus*). *Syntype*: Open plains or sand covered gravel, near Bolgart, viii.1949, *R. Erickson s.n.* (MEL not found).

Illustrations: Erickson (1951) plate 6: 20 (as *T. spiralis* var. *pulchella*); Nicholls (1951) plate 45, figs c & g (as *T. spiralis* var. *pulchella*); Nicholls (1969) plate 47, figs c & g (as *T. spiralis* var. *pulchella*); Heberle (2000) page 250 (as *T. spiralis*); Jones (2006) page 253; Brown *et al.* (2008) page 321.

Virtually glabrous terrestrial *herb*. *Tubers* obloid to ovoid, 1–1.5 cm long, 3.5–6 mm wide, fleshy. *Leaf* ovate at base, narrowing abruptly and linear to linear-lanceolate above, 5–8 cm long, 3–6 mm wide, curved or somewhat spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins sometimes shallowly lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 9–20 cm tall, more or less straight. *Scape* 0.5–1 mm diam., wiry, green or purplish. *Sterile bract* solitary, lanceolate to ovate, 15–30 mm long, 3–5 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bract* ovate to obovate, 6–15 mm long, 3–5 mm wide, green or purplish, margins connate at base, sheathing the pedicels, apex acute to acuminate. *Pedicels* 5–16 mm long, slender. *Ovary* narrow-obovoid, 4–10 mm long, 1.5–3 mm wide. *Flower* usually solitary, 21–35(–45) mm diameter, pale to deep pink or purplish, sepals often darker than petals, usually with darker pink to purplish spots and blotches arranged in longitudinal lines on sepals and sometimes also on petals, opening freely in mild weather. *Perianth segments* 8–18(–25) mm long, 2–8 mm wide, concave to almost flat, petals and lateral sepals often somewhat deflexed; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments; *lateral sepals* ovate-lanceolate to lanceolate, slightly asymmetric, acute to subacute; *petals* ovate-lanceolate to lanceolate, slightly asymmetric, acute; *labellum* lanceolate to linear-lanceolate, acute to obtuse, smaller than other segments. *Column* erect from the end of ovary, 4.5–6.5 mm long,

2.5–3 mm wide, broadly winged, similarly coloured to perianth; *post-anther lobe* vestigial, apical margin covered with an arc of digitate to globose glands 0.2–0.6 mm long; *auxiliary lobes* absent; *lateral lobes* more or less parallel, elliptic to suborbicular, 1.8–2.8 mm long, 0.9–1.3 mm wide, curved, erect or obliquely erect, stipitate, fleshy, rugulose, orange or yellow. *Anther* inserted at apex of column, obloid, 2.5–3.5 mm long, 1.5–2 mm wide, projecting forward at about 90° to column, orange or yellow, the connective produced into a fleshy beak 0.8–1.5 mm long, dorsal surface pubescent, ventral surface channelled; *pollinarium* 1.5–2 mm long; *viscidium* elliptic, c. 0.7 mm long, c. 0.5 mm wide; *pollinia* coherent, cream. *Stigma* situated c. midway along column, orbicular or transversely broad-elliptic, c. 2 mm long, c. 2 mm wide, concave, margins irregular. *Capsules* not seen. (Fig. 3, Fig. 10 d–f)

***Selected specimens examined*: WESTERN AUSTRALIA:** Mokine Nature Reserve, 1.viii.1985, *G.J. Keighery & J.J. Alford 171* (PERTH 792187); Wongan Hills, ix.1967, *J. Tonkinson s.n.* (PERTH 277207); 25 miles S of Tammin (Tammin National Park), 2.viii.1968, *R.D. Royce 8469* (PERTH 277231); Wongan Hills, 1.viii.1979, *D. Kruske s.n.* (PERTH 306924); Bolgart, 8.viii.1951, *R. Erickson s.n.* (PERTH 924962); 24.6 km E along York Road from Great Eastern Hwy, 100 m E from track to Mt Observation, 28.viii.1985, *R. Peakall 6* (PERTH 561363); 11 miles 5E of Ongerup, 26.viii.1973, *K. Newbey 3732* (PERTH 276707); Watheroo, viii.1903, *C. Andrews s.n.* (PERTH 277657); Wongan Hills, 5.ix.1924, *Carne & Gardner s.n.* (PERTH 277649); Wongan Hills, near Reserve Station, 11.ix.1973, *P. Mann s.n.* (PERTH 283908); Dragon Rocks Nature Reserve No. 36128, Dragon Rocks, 20.ix.1991, *A.M. Coates 2841* (PERTH 5152968) York-Quellington Road, 26.xiii.1906, *?O.H. Sargent s.n.* (PERTH 277665); Bouncer Road, Flynn State Forest, York, 28.viii.2007, *F. & J. Hort 3007* (MEL 2296501, PERTH 05441536).

***Distribution and habitat*:** Endemic to south-western Western Australia, between Watheroo, Ongerup and Hyden, growing in dry inland areas through the wheatbelt. Grows in heathland or Wandoo woodland, often near rock outcrops, on dry granitic or lateritic sandy loam soils. Altitude: 150–450 m.

***Conservation status*:** Apparently quite rare, but very widespread and conserved. Suggest 3RC by criteria of Briggs and Leigh (1996) and Near Threatened (NT) by criteria of IUCN (2001).

***Flowering period*:** July to September.

***Pollination biology*:** The freely opening flowers, functional viscidium, coherent pollen and sporadic production of seed capsules would indicate that this species is most likely entomophilous.

Notes: *Thelymitra maculata* is closely related to *T. spiralis* but the former usually has a single, generally smaller flower that is strongly spotted, particularly on the sepals, somewhat deflexed petals and lateral sepals, a narrower column often with suborbicular, orange lateral lobes, a less spirally twisted leaf that is barely auriculate at the base and a preference for drier inland habitats. *Thelymitra matthewsii* from eastern Australia and New Zealand and *T. uliginosa* grow in more mesic habitats, have a more spirally twisted leaf that is strongly auriculate at the base and smaller, darker coloured, unspotted flowers.

The raising of *T. spiralis* var. *pulchella* Nicholls to species rank requires the coining of a new epithet as 'pulchella' is already occupied at specific rank by the New Zealand endemic *T. pulchella*.

***Etymology*:** Latin *macula*, spot; the sepals, and also sometimes the petals, of this species are strongly spotted.

3. *Thelymitra uliginosa* Jeanes *sp. nov.*

Thelymitra matthewsii Cheesem. affinis sed habitu plerumque elatiore, floribus plerumque binis majoribus pallidioribus et minus striatis, columna angustiore, lobis lateralibus minus manifeste stipitatis, habitatione humidiore et occidentaliore differt.

***Type*:** Western Australia. Mount Chance Track, Walpole-Nornalup National Park, 8.viii.1994, *W. Jackson BJ 271* (holotype PERTH 04447379).

Thelymitra matthewsii auct. non Cheesem.: A.S. George (1971). *Nuytsia* 1(2): 194 *p.p.*; N. Hoffman & A. Brown (1984) *Orchids of South-West Australia* 34 *p.p.*

Illustrations: Hoffman and Brown (1984) page 34 (as *T. matthewsii*); Jones (2006) page 254; Brown *et al.* (2008) page 321.

Virtually glabrous terrestrial *herb*. *Tubers* not seen. *Leaf* ovate-auriculate at base, narrowing abruptly and linear above, 5–10 cm long, 4–8 mm wide, usually spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins often lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 10–25(–35) cm tall, more or less straight. *Scape* 0.5–1.2 mm diam., wiry, green or purplish. *Sterile*

bract solitary, lanceolate to ovate, 15–40 mm long, 3–8 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate to obovate, 6–18 mm long, 3–7 mm wide, green or purplish, margins connate at base, sheathing the pedicels, apex acute to acuminate. *Pedicels* 4–20 mm long, slender. *Ovary* narrow-obovoid, 5–12 mm long, 1.5–4 mm wide. *Flowers* 1, or less often 2, 15–30 mm diameter, pink, mauve, blue or purplish with darker longitudinal veins inside, sepals greenish with pink to purplish veins outside, opening tardily in warm weather. *Perianth segments* 6–15 mm long, 2–7 mm wide, concave to almost flat, stiffly spreading, often shortly apiculate; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments; *lateral sepals* ovate-lanceolate to lanceolate, slightly asymmetric, acute to acuminate; *petals* ovate-lanceolate to lanceolate, slightly asymmetric, acute to acuminate; *labellum* lanceolate to linear-lanceolate, acute, smaller than other segments. *Column* erect from the end of ovary, 3.5–5.5 mm long, 2.5–3 mm wide, broadly winged, similarly coloured to perianth; *post-anther lobe* vestigial, apical margin covered with an arc of digitate to globose glands 0.2–0.4 mm long; *auxiliary lobes* absent; *lateral lobes* more or less parallel, ovate or elliptic, 1.5–2.5 mm long, 0.8–1.4 mm wide, erect or obliquely erect, stipitate, fleshy, rugulose, yellow. *Anther* inserted at apex of column, obloid, 2.5–3.2 mm long, 1.5–2 mm wide, projecting forward at about 90° to column, yellow, the connective produced into a fleshy beak 0.8–1.5 mm long, dorsal surface pubescent, ventral surface channelled; *pollinarium* 1.5–2.5 mm long; *viscidium* elliptic, c. 0.6 mm long, c. 0.5 mm wide; *pollinia* friable, mealy, cream. *Stigma* situated c. midway along column, orbicular to transversely broad-elliptic, c. 2 mm long, c. 2 mm wide, concave, margins irregular. *Capsules* obovoid, 7–15 mm long, 4–8 mm wide, erect, ribbed. (Fig. 4, Fig. 10 g–i)

***Selected specimens examined*: WESTERN AUSTRALIA:** Lochyer, Albany, 10.viii.1979, *R. Heberle s.n.* (PERTH 276715); Just W of Walpole, SW Highway, 25.viii.1978, *T. Wilson s.n.* (PERTH 277169); Denmark Shire. Little Lindesay, 0.5 km along track to N from main walk track, 30.viii.1996, *B.G. Hammersely 1613* (PERTH 4627288); Mount Lindesay, 22.viii.1995, *S. Barrett 574* (PERTH 4136705); Boronia Reserve, near Goodchild's property, c. 14 miles direct NNW of Albany, 14.ix.1965, *A.C. Beauglehole 12855* (PERTH 4258037); Mt Chance track, NW of Walpole, 18.viii.1995, *C. French DLJ14258* (CANB 611730); Darling district: Rock verge, 1.4 km N of Inlet R, Hwy 1, 16.viii.1995, *C. French DLJ14257* (CANB 611729); Darling district: William Bay National Park, ranger's house, 21.x.1994, *W. Jackson DLJ13653* (CANB 611731); Stirling Range Drive, 3.2 km W of Chester Pass Road, 100 m W of old access track to Mt Hassell Picnic area, 16.x.1999, *C.J. French 2093* (CANB 611754); George St Reserve, Albany, 6.vii.1987, *R. Heberle 12* (AD RH12); Brookton Highway, 42–43 mile pegs, 10.ix.1960, *A.S. George 1514* (PERTH 276693).

***Distribution and habitat*:** Endemic to south-west Western Australia, mostly between Bremer Bay and Augusta, with a disjunct collection from the Darling Ranges east of Perth. Grows in open forest amongst sedges and rushes in and around seasonal swamps in moist sandy clay soils. Altitude: 10–400 m.

***Conservation status*:** Uncommon to rare, but widespread and conserved. Suggest 3RC by criteria of Briggs and Leigh (1996) and Near Threatened (NT) by criteria of IUCN (2001).

***Flowering period*:** July to October.

***Pollination biology*:** This species is facultatively autogamous.

***Notes*:** *Thelymitra uliginosa* is most closely related to the eastern Australian and New Zealand species *T. matthewsii*, but the latter grows in drier habitats, is generally shorter, has a single (very rarely two) slightly smaller, darker, more prominantly striated flower and a broader column with more obviously stipitate lateral lobes. *Thelymitra uliginosa* is also related to *T. spiralis* and *T. maculata* but those species have generally larger, insect-pollinated flowers that are often spotted or blotched.

***Etymology*:** Latin *uliginosa*, moist, wet; this species prefers to grow in seasonally wet substrates.

4. *Thelymitra matthewsii* Cheesem., *Trans. & Proc. New Zealand Inst.* 43: 177 (1911)

Macdonaldia matthewsii (Cheesm.) Szlach. *Fragm. Fl. Geobot.*, Suppl. 3: 113 (1995). ***Type*:** New Zealand: Mongonui Country, low hills between Lake Tongonge and the coast, *R.H. Matthews s.n.* (holotype K).

Thelymitra daltonii R.S.Rogers, *Trans. & Proc. Roy. Soc. South Australia* 54: 42–4 (1930). (as *T. D'Altonii*) *Type*: Halls Gap, Grampians, 26.ix.1929, *A.B. Braine & M. Braine s.n.* (lectotype AD!). *Syntype*: Victoria. Halls Gap, Grampians, 8.x.1922, *C.W. D'Alton s.n* (AD!).

Illustrations: Nicholls (1951) plate 47; Nicholls (1969) plate 46; Gray (1971) page 39; Bates and Weber (1990)

plates 214 & 215; Weber and Entwisle (1994) page 850; Backhouse and Jeanes (1995) page 348; St George (1999) page 147; Jeanes and Backhouse (2004) page 96; Jeanes and Backhouse (2006) page 195; Jones (2006) page 253.

Virtually glabrous terrestrial *herb*. *Tubers* ovoid, 1–2 cm long, 5–10 mm wide, fleshy. *Leaf* ovate-auriculate at base, narrowing abruptly and linear above, 3–7 cm long, 3–7 mm wide, spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 9–15 cm tall, more or less straight. *Scape* 0.7–1 mm diam., wiry, green or purplish. *Sterile bract* solitary, lanceolate to ovate, 10–30 mm long, 3–7 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bract* ovate to obovate, 5–12 mm long, 2–6 mm wide, green or purplish, margins connate at base, sheathing the pedicels, apex obtuse to acute. *Pedicels* 2–12 mm long, slender. *Ovary* narrow-obovoid, 4–10 mm long, 2–4 mm wide. *Flower* 1, very rarely 2, 15–20(–27) mm diameter, purplish with darker longitudinal stripes, sepals usually more reddish than petals and labellum, opening freely in warm weather. *Perianth segments* 6–10(–13) mm long, 2–6(–8) mm wide, concave, stiffly spreading; *dorsal sepal* ovate to obovate, subacute, larger than other segments; *lateral sepals* lanceolate to narrow-ovate, acute; *petals* lanceolate to narrow-ovate, acute; *labellum* lanceolate to narrow-ovate, acute, smaller than other segments. *Column* erect from the end of ovary, 4–5.5 mm long, 2.5–4 mm wide, broadly winged, purplish; *post-anther lobe* vestigial, apical margin irregular, covered with an arc of globose glands c. 0.2 mm long; *auxiliary lobes* absent; *lateral lobes* more or less parallel, ovate to elliptic, 1.5–2 mm long, 0.7–1.3 mm wide, obliquely erect or bent forwards, plano-convex, sometimes twisted, shortly stipitate, fleshy, smooth or minutely tuberculate, yellow. *Anther* inserted at apex of column, obloid, 2–3 mm long, 1.5–2 mm wide, projecting forward at about 90° to column, extending beyond lateral lobes, yellow, the connective produced into a fleshy beak 0.4–0.8 mm long, dorsal surface minutely tuberculate, ventral side channelled; *pollinarium* 1.5–2.5 mm long; *viscidium* circular, c. 0.5 mm diam.; *pollinia* friable, mealy, white. *Stigma* situated c. midway along column, orbicular or transversely broad-elliptic, 1.5–2.5 mm long, 2–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–18 mm long, 4–7 mm wide, erect, ribbed. (Fig. 5, Fig. 11 a–c)

***Selected specimens examined*: SOUTH AUSTRALIA:** Didicoolum Rd, SE, 9.ix.1964, *D. Hunt 2120* (AD 98620057 & AD 96527066); South Lofty District: Kuitpo, ix.1981, *R.J. Bates 2088* (AD 98207132); Upper South-east District: c. 17 km SE of Meningie, 25.viii.1974, *C.T. James, J. Davies & K. Thiele s.n.* (AD 97436001); Upper South-east District: Messent Wildlife Reserve, 10.ix.1968, *R.H. Kuchel 2760* (AD 97641516); Kangaroo Island District: Hundred of Gosse, 8.ix.1974, *G. Jackson 1001* (AD 97S21085). **VICTORIA:** East Gippsland, near Genoa, 20.ix.1986, *A.B. Peisley s.n.* (MEL 1SS1480); Grampians, Mirranatwa Gap, 13.ix.1976, *A.C. Beauglehole 55435 & C. & D. Woolcock* (MEL 652734); Pomonal, 16.ix.1934, *?L. Banfield s.n.* (MEL 573526); South Gippsland. Mūilungdung forest; Massey's Rd 3 km N of Boundary Rd; 9 km. N. of Woodside, 30.ix.1979, *K.W. Black s.n.* (MEL 599316); Genoa, East Gippsland, ix.1940, *N.A. Wakefield s.n.* (MEL 114448); Grampians. On W side of Henham Tk approx. 200 m from Mirranatwa Gap Rd, 14.ix.1979, *J. Eichler s.n.* (MEL 1515748); East Gippsland. Genoa, ix.1939, *N.A. Wakefield s.n.* (MEL 1S13162); Devil's Garden, the Grampians, x.1930, *A.B. Braine s.n.* (MEL 625491); Genoa, 23.ix.1988, *A. Peisley DLJ2908* (CANB 8806571); Black Range, 27.ix.1987, *R.J. Bates 10463* (AD 98741363). **NEW ZEALAND:** North Island: Kaitaia near Lake Tangonge, 1914, *H.B. Matthews s.n.* (AD 97435002); North Island: Kaitaia near Lake Tangonge, 13.ix.1914, *H.B. Matthews s.n.* (AD 97435001); North Island: Kaitaia, ix.1924, *H.B. Matthews s.n.* (NSW 181305); North Island. Aupouri Ecological Region and District, Kaitaia, ix.1911, *H.B. Matthews s.n.* (AK *25890*); Near Kaitaia, *H.B. Matthews s.n.* (WELT 3767).

***Distribution and habitat*:** South Australia, Victoria and New Zealand. Grows in open forest and heathy woodlands on well-drained sand and clay loam soils. Favours disturbed areas such as road sides, gravel pits, disused tracks and animal trails. Altitude: 20–300 m.

***Conservation status*:** Widespread and conserved, but extremely rare and probably endangered. Suggest 3EC by criteria of Briggs and Leigh (1996) and Endangered (EN) by criteria of IUCN (2001).

***Flowering period*:** August to early October.

***Pollination biology*:** This species is facultatively autogamous.

***Notes*:** *Thelymitra matthewsii* is most closely related to *T. uliginosa* from Western Australia, but the latter grows in swampy habitats, is often taller, has either one

Figure 4-9. 4. *Thelymitra uliginosa* (photograph by Andrew Brown, Department of Environment and Conservation, Western Australia); **5.** *Thelymitra matthewsii* (photograph by Jeff Jeanes, Royal Botanic Gardens, Melbourne); **6.** *Thelymitra apiculata* (photograph by Andrew Brown, Department of Environment and Conservation, Western Australia); **7.** *Thelymitra variegata* (photograph by Ron Heberle); **8.** *Thelymitra speciosa* (photograph by Andrew Brown, Department of Environment and Conservation, Western Australia); **9.** *Thelymitra pulcherrima* (photograph by Andrew Brown, Department of Environment and Conservation, Western Australia).

or two flowers that are slightly larger and paler pink or purple in colour and has less obviously stipitate lateral lobes on the column. Also related to *T. matthewsii* are *T. spiralis* and *T. maculata*, but these are endemic to Western Australia and have generally larger insect pollinated flowers.

5. *Thelymitra apiculata* (A.S. George) M.A.Clem. & D.L.Jones, *Austral. Orchid Res.* 1: 137 (1989)

Thelymitra variegata (Lindl.) F.Muell. var. *apiculata* A.S.George, *Nuytsia* 5(1): 62, f. 3L (1984). *Macdonaldia apiculata* (A.S. George) Szlach. *Fragm. Fl. Geobot.*, Suppl. 3: 112 (1995). ***Type***: 7 miles (11 km) SE of Badgingarra homestead, Western Australia, 19.vi.1961, *A.S. George 2598* (holotype PERTH!).

Illustrations: Hoffman and Brown (1984) page 40 (as *Thelymitra* sp.); Hoffman and Brown (1992) page 256; Hoffman and Brown (1998) page 256; Jones (2006) page 254; Brown *et al.* (2008) page 323.

Virtually glabrous terrestrial *herb*. *Tubers* not seen. *Leaf* linear to lanceolate, 5–13 cm long, 2.5–7 mm wide, erect, curved, canaliculate, fleshy, dark green with a purplish base, sheathing at base where pubescent, apex subacute. *Inflorescence* 15–35 cm tall, somewhat flexuose at nodes. *Scape* 0.8–1.8 mm diam., wiry, green or purplish. *Sterile bract* usually solitary, rarely 2, linear-lanceolate to lanceolate, 20–65 mm long, 2–6 mm wide, green or purplish, sheathing only at very base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate-lanceolate to obovate-lanceolate, 4.5–37 mm long, 2–6 mm wide, green or purplish, margins connate at base and sheathing the pedicels, apex diverging from scape, acute to acuminate. *Pedicels* 2–15 mm long, slender. *Ovary* narrow-obovoid, 3–10 mm long, 1–3 mm wide, curved. *Flowers* 2–6, 23–40 mm diameter, usually bright purple to pinkish purple, often with darker spots and golden yellow margins, glossy, opening freely in mild weather. *Perianth segments* 9–20 mm long, 1.5–7 mm wide, concave to almost flat, stiffly spreading; *dorsal sepal* ovate to ovate-lanceolate, acute, usually broader than other segments; *lateral sepals* lanceolate to linear-lanceolate, often asymmetric, acute to acuminate; *petals* lanceolate to linear-lanceolate, often asymmetric, acute to acuminate; *labellum* lanceolate to linear-lanceolate, acute to acuminate, smaller than other segments. *Column* erect from the end of ovary, 3.5–7 mm long, 2.5–3.5 mm wide, broadly winged, similarly coloured to perianth; *post-anther lobe* vestigial, apical margin covered with an arc of digitate glands 0.1–0.7 mm long; *auxiliary lobes* absent; *lateral lobes* oblong to elliptic, 3–4.5 mm long, 0.8–1.3 mm wide, erect or obliquely erect, stipitate, fleshy, rugulose, yellow or orange, each terminated by a fine needle-like point 0.6–1.1 mm long. *Anther* more or less terminal, obloid, 4–6 mm long, 1.5–2.5 mm wide, projecting forward at about 45° to column, yellow, the connective produced into a fleshy beak 2–4 mm long, surface papillose, ventral surface channelled; *pollinarium* 1.5–2.5 mm long; *viscidium* elliptic, c. 0.8 mm long, c. 0.5 mm wide; *pollinia* coherent, cream. *Stigma* situated midway along column, orbicular to broadly transverse-elliptic, c. 2.5 mm long, c. 2 mm wide, concave, margins irregular. *Capsules* not seen. (Fig. 6, Fig. 11 d–f)

Selected specimens examined: **WESTERN AUSTRALIA**: Stockyard Gully, Jurien Bay, vii.1963, *W.H. Butler 14* (PERTH 27B149); Coomallo–Jurien road, 2–3 km W of Brand Highway, vii.1981, *P. Nihulinsky s.n.* (PERTH 294756); 2.6 km from Brand Highway up McNamara Rd, 5.vii.1979, *R.J. Cranfield 1275* (PERTH 27B173); North Wongonderrah Rd at junction Wongonderrah Rd and Brand Hwy, 12.vi.198B, *B.J. Keighery s.n.* (PERTH 1709496); 5.6 km E of Brand Hwy along Mullering Road, 2.vii.1992, *R. Cranfield & P. Spencer 8297* (PERTH 252B371); Just W of Brand Hwy on Coomallo–Jurien Road, vi.19B0, *P. Nihulinsky s.n.* (PERTH 27B165); Mogumber Mission, vi.1965, *M.C. George s.n.* (PERTH 27B1B1); Mogumber West Road, 14.4 km E of Brand Hwy, 1B.vi.199?, *C.J. French DLJ13969* (CANB 60936B); Mogumber West Road, E of Brand Hwy, 1B.vi.1994, *C.J. French DLJ13036* (CANB 95171B4); Mogumber West Road, E of Brand Hwy, 1B.vii.1996, *C.J. French ORG85* (CANB 9707753).

Distribution and habitat: Endemic to south-western Western Australia, between Mogumber and Eneabba. Grows on the tops of lateritic hills amongst dense low shrubs in pockets of shallow sandy soil. Altitude: 100–200 m.

Conservation status: Currently classified in Western Australia as a Priority 4–Rare taxon.

Flowering period: June to July.

Pollination biology: The large, freely opening flowers, functional viscidium, coherent pollen and very sporadic production of seed capsules would indicate that this species is probably entomophilous.

Notes: *Thelymitra apiculata* is closely related to

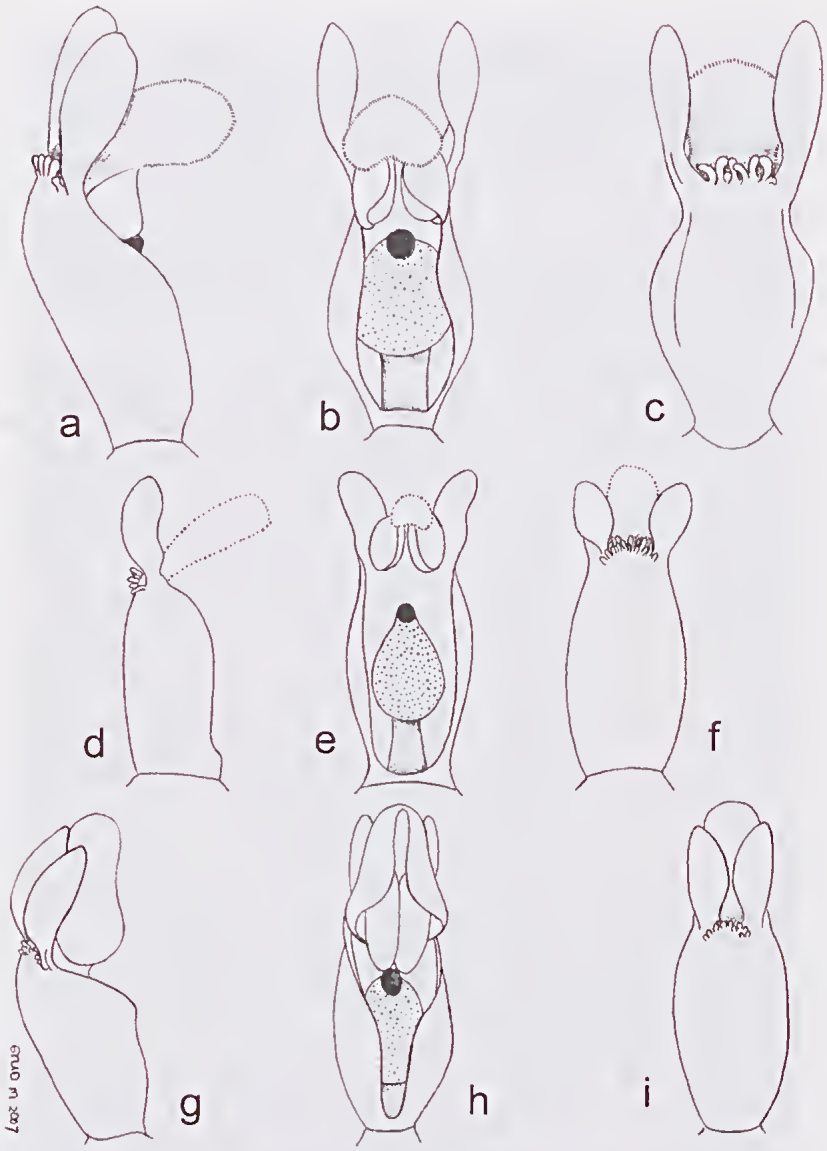

Figure 10. *Thelymitro spirolis*: **a** column from side ×8; **b** column from front ×8; **c** column from rear ×8. *Thelymitro moculoto;* **d** column from side ×5; **e** column from front ×5; **f** column from rear ×5. *Thelymitro uliginosa;* **g** column from side ×8; **h** column from front ×8; **i** column from rear ×8.

T. pulcherrima, *T. speciosa* and *T. variegata*, but the former species generally flowers earlier and has distinct needle-like points on the lateral lobes of the column.

6. *Thelymitra variegata* (Lindl.) F.Muell., *Fragm.* 5: 98 (1865)

Macdonaldia variegata Lindl. *Edwards's Bot. Reg.* appendix to vols 1–23 [*Sketch Veg. Swan R.*]: 50 (1839–40). ***Type***: Swan River, 1838, *J. Drummond s.n.* (holotype K-LINDL!, isotypes BM!, K).

Thelymitra porphyrosticta F.Muell., *Fragm.* 5: 97–8 (1865) *p.p.* Lectotype *hic designatus*: *Ad margines paludum prope flumen Salt River et in vallibus humidis prope Kalgan* [Margins of swamps near Salt River and moist valleys, near Kalgan], *Maxwell s.n.* Kalgan River, MEL 114390!; isolectotype K *n.v.*

Illustrations: Erickson (1951) plate 4, plate 6: 19;

Nicholls (1951) plate 46; Nicholls (1969) plate 48; Jones (1988) page 305; Hoffman and Brown (1984) pages 12, 12 & 38; Hoffman and Brown (1992) page 255; Hoffman and Brown (1998) page 255; Heberle (1999) pages 49, 73 (lower) & 75; Jones (2006) page 255; Brown *et al.* (2008) page 323.

Virtually glabrous, somewhat glaucous terrestrial *herb*. *Tubers* ovoid, 1–2 cm long, 4–8 mm wide, fleshy. *Leaf* ovate-auriculate at base, narrowing abruptly and linear to linear-lanceolate above, 5–15 cm long, 5–10 mm wide, erect, curved or spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins often lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 15–35 cm tall, more or less straight. *Scape* 1–2 mm diam., wiry, green or purplish. *Sterile bract* solitary, rarely 2, lanceolate to ovate, 15–65 mm long, 4–9 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate to obovate, 5–27 mm long, 2.5–8 mm wide, green or purplish, margins connate at base, sheathing the pedicels, apex acute to acuminate. *Pedicels* 4–20 mm long, slender. *Ovary* narrow-obovoid, 5–13 mm long, 1.5–3 mm wide, curved. *Flowers* 1–6, 30–56 mm diameter, usually predominantly reddish, purplish or violet, variegated, mostly with darker spots or blotches, often with yellow margins, with an overall glossy iridescent sheen, opening freely in warm weather. *Perianth segments* (10–)14–27 mm long, 2.5–10 mm wide, concave to almost flat, stiffly spreading; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments; *lateral sepals* lanceolate to linear-lanceolate, slightly asymmetric, acute to acuminate; *petals* lanceolate to linear-lanceolate, slightly asymmetric, acute to acuminate; *labellum* lanceolate to linear-lanceolate, acute to acuminate, smaller than other segments. *Column* erect from the end of ovary, 5–7 mm long, 3–5 mm wide, broadly winged, similarly coloured to perianth; *post-anther lobe* vestigial, apical margin covered with an arc of digitate glands 0.4–1 mm long; *auxiliary lobes* absent; *lateral lobes* parallel or diverging slightly, oblong to elliptic, 3–5 mm long, 0.9–2 mm wide, straight to shallowly s-shaped, erect or obliquely erect, stipitate, fleshy, rugulose, yellow or orange. *Anther* inserted at apex of column, obloid, 4–6 mm long, 1.5–2.5 mm wide, projecting forward at about 45° to column, yellow or orange, the connective produced into a fleshy beak 1.8–2.7 mm long, dorsal surface papillate, ventral surface channelled, papillate; *pollinarium* 2–3.2 mm long; *viscidium* elliptic, c. 0.7 mm long, c. 0.5 mm wide; *pollinia* coherent, cream. *Stigma* situated c. midway along column, orbicular to transversely broad-elliptic, 2.5–3 mm long, 1.7–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–20 mm long, 5–8 mm wide, erect, ribbed. (Fig. 7, Fig. 11 g–i)

Selected specimens examined: **WESTERN AUSTRALIA**: Albany, 6.ix.1935, *?E.O. s.n.* (MEL 573915); Jandakot, viii.1957, *R. Filsan 45* (MEL 606281); King George Sound, 12.viii.1884, *Franklyn 67* (MEL 114392); Albany district, 14.viii.1963, *R. Oliver s.n.* (PERTH 302228); Capel, 14.ix.1951, *R.D. Royce 3790* (PERTH 278661); Russell Road, Jandakot, 16.viii.1959, *A.S. George 116* (PERTH 279188); Canning Bridge, 27.viii.1948, *R.D. Royce 2618* (PERTH 279161); Perth, viii.1900, *A. Purdie s.n.* (PERTH 279129); Site 145, 2 km SSE of Mount Lindesay, off Nutcracker Road, 20.iii.1997, *K.A. Redwood 075* (PERTH 4795474); Applecross, ix.1901, *C. Andrews s.n.* (PERTH 279579); Wanneroo, ix.1919, *W.B. Alexander s.n.* (PERTH 278696); Albany, 28.x.1988, *H. Richards DLJ2920* (CANB 8806583).

Distribution and habitat: Endemic to south-west Western Australia, between Perth and Albany, mostly within 100 km of the coast. Grows in open sandy clearings amongst grass tussocks or rushes in shrubby vegetation, mostly on well-drained deep sandy soils. Altitude: 10–300 m.

Conservation status: Uncommon to rare, but widespread and well conserved. Suggest 3RC by criteria of Briggs and Leigh (1996) and Near Threatened (NT) by criteria of IUCN (2001).

Flowering period: August to early October.

Pollination biology: The large, freely opening flowers, functional viscidium, coherent pollen and sporadic production of seed capsules would indicate that this species is probably entomophilous.

Notes: *Thelymitra variegata* is most closely related to *T. apiculata*, *T. pulcherrima* and *T. speciosa*. *Thelymitra apiculata* can be distinguished by the presence of apiculate lateral lobes on the column. *Thelymitra pulcherrima* has a more northerly distribution, often grows in lateritic soils and usually has smaller flowers, the perianth of which have a different colour combination. *Thelymitra speciosa* has a more easterly

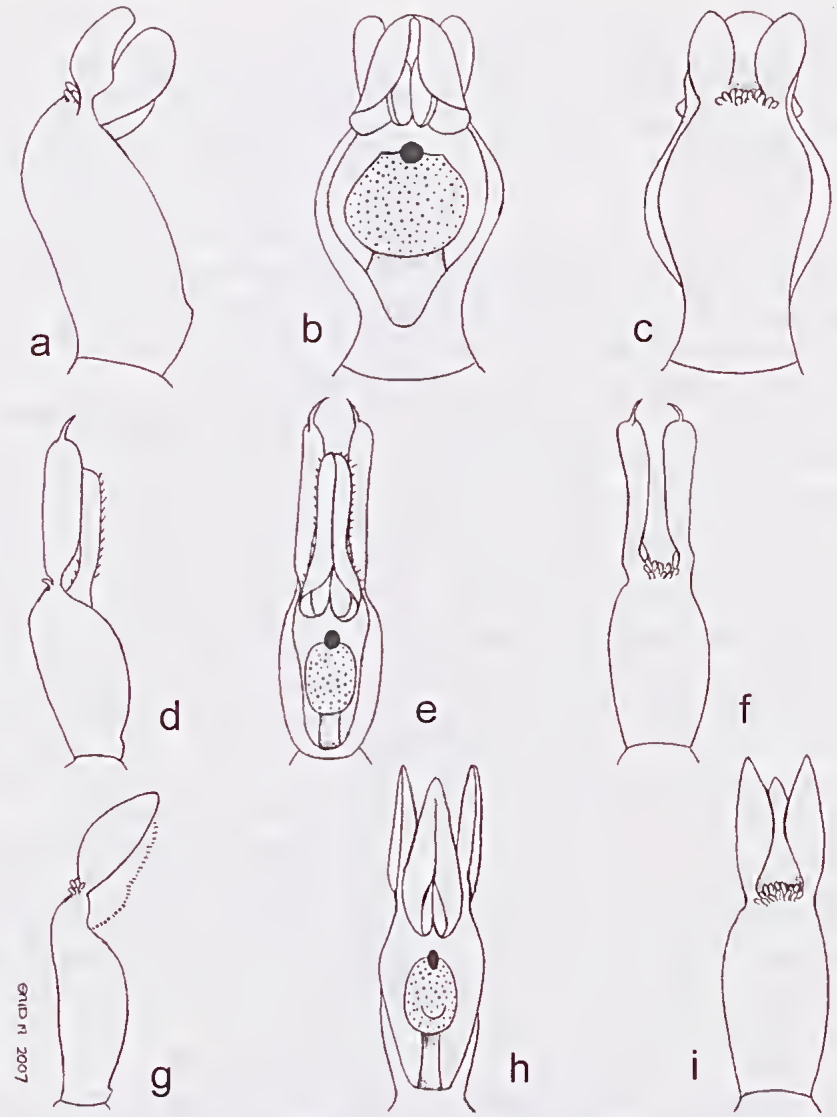

Figure 11. *Thelymitra matthewsii*: **a** column from side ×8; **b** column from front ×8; **c** column from rear ×8. *Thelymitra apiculata;* **d** column from side ×5; **e** column from front ×5; **f** column from rear ×5. *Thelymitra variegata;* **g** column from side ×5; **h** column from front ×5; **i** column from rear ×5.

distribution, prefers heavy clay loam soils, has a more spiralled leaf and usually a single flower whose perianth has a different colour combination.

Mueller's *T. porphyrosticta*, that was described from specimens collected by Maxwell near Salt River and Kalgan in Western Australia, consists of two separate taxa. Those from Kalgan River are referable to *T. variegata* (lectotypified above) and those from Salt River to *T. spiralis* (rejected syntype). A specimen at Kew (not seen by me) collected by Maxwell at Kalgan River is most likely an isolectotype (George 1971).

7. *Thelymitra speciosa* Jeanes, *sp. nov.*

Thelymitra. variegatae (Lindl.) F.Muell *affinis sed flore plerumque unica, scapo breviore, segmentis floralibus praecipue purpueris. folio magis valde ciricinato e habiatione terrarum argillosarum differt.*

Type: Western Australia. W of junction of Twertup Ck & Fitzgerald R., 11.vii.1970, *A.S. George 9904* (holotype PERTH 306967).

Illustrations: Hoffman and Brown (1998) page 455 (as *T.* aff. *variegata*); Heberle (1999) pages 73 (upper), 74 & 76 (all as *T. variegata*); Jones (2006) page 255; Brown *et al.* (2008) page 321.

Virtually glabrous, somewhat glaucous terrestrial *herb*. *Tubers* not seen. *Leaf* ovate-auriculate at base, narrowing abruptly and linear to linear-lanceolate above, 5–10 cm long, 4–10 mm wide, erect, spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins often lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 5–20 cm tall, more or less straight. *Scape* 0.5–1.2 mm diam., wiry, green or purplish. *Sterile bract* solitary, lanceolate to ovate, 10–35 mm long, 3–8 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate to obovate, 5–15 mm long, 3–8 mm wide, green or purplish, margins connate at base, sheathing the pedicels, apex acute to acuminate. *Pedicels* 5–15 mm long, slender. *Ovary* narrow-obovoid, 5–10 mm long, 1.5–4 mm wide, curved. *Flower* solitary, rarely 2, 25–52 mm diameter, usually predominantly purplish, with broad, deep reddish-gold edges to the perianth segments and yellowish margins, spotted or blotched with purple, with a glossy iridescent sheen, opening freely in warm weather. *Perianth segments* 10–25 mm long, 2.5–10 mm wide, concave to almost flat, stiffly spreading; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments; *lateral sepals* lanceolate to linear-lanceolate, often slightly asymmetric, acute to acuminate; *petals* lanceolate to linear-lanceolate, often slightly asymmetric, acute to acuminate; *labellum* lanceolate to linear-lanceolate, acute to acuminate, smaller than other segments. *Column* erect from the end of ovary, 5–7 mm long, 3–5 mm wide, broadly winged, purplish; *post-anther lobe* vestigial, apical margin covered with an arc of digitate glands 0.4–0.7 mm long; *auxiliary lobes* absent; *lateral lobes* parallel or diverging slightly, oblong to elliptic, 3–5.5 mm long, 1–2.1 mm wide, straight to shallowly s-shaped, erect or obliquely erect, stipitate, fleshy, rugulose, yellow or orange. *Anther* inserted near apex of column, obloid, 4–6 mm long, 1.5–2.5 mm wide, projecting forward at about 45° to column, yellow or orange, the connective produced into a fleshy beak 2–3 mm long, surface papillate, ventral surface channelled; *pollinarium* 2–3.2 mm long; *viscidium* elliptic, c. 0.8 mm long, c. 0.6 mm wide; *pollinia* coherent, cream. *Stigma* situated c. midway along column, orbicular to transversely broad-elliptic, 2.5–3 mm long, 1.8–2.5 mm wide, concave, margins irregular. *Capsules* not seen. (Fig. 8, Fig. 12 a–c)

Specimens examined: **WESTERN AUSTRALIA:** 5th Dongolocking Reserve, 25.viii.1984, *G.J. Keighery 7238* (PERTH 278203); Tarin Rock Reserve, 26.viii.1984, *G.J. Keighery 7245* (PERTH 302201); 3 km N of Gibson, 11.viii.1951, *R.D. Royce 3621* (PERTH 278688); Slopes of Mt 8land, Fitzgerald River National Park, 12.vii.1970, *G.J. Keighery 143* (PERTH 306975); c. 28 km W of Ravensthorpe and 13 km N of the Ravensthorpe–Ongerup Rd, 14.viii.1968, *P.G. Wilson 7107* (PERTH 278238); 2 km SE of Mt Maxwell, 8.vii.1974, *K. Newbey 4257* (PERTH 278653); 8oyatup Hill, 71 miles E of Esperance, N side of Fisheries Road, 4.x.1978, *D.R. Voigt 63pp* (PERTH 278211).

Distribution and habitat: Endemic to south-western Western Australia, between the Stirling Ranges and Lake Grace and extending eastwards beyond Esperance. Grows among low shrubs in heavy clay-loam soils that become water-logged in winter. Altitude: 10–300 m.

Conservation status: Widespread and conserved, but probably vulnerable. Suggest 3VC by criteria of Briggs and Leigh (1996) and Vulnerable (VU) by criteria of IUCN (2001).

Flowering period: June to early September.

Pollination biology: The large, freely opening flowers, functional viscidium, coherent pollen and sporadic production of seed capsules would indicate that this species is primarily entomophilous.

Notes: *Thelymitra speciosa* is most closely related to *T. apiculata*, *T. pulcherrima* and *T. variegata*. The former can be distinguished by a combination of characters including the tendency of the leaf to spiral more tightly, the usually solitary flower on a short scape, perianth segments that are predominantly purple in colour with broad reddish-gold edges and yellow margins and the lateral lobes on the column that are not apiculate at the apex.

Etymology: Latin *speciosa*, showy, handsome, beautiful; a very spectacular and showy species.

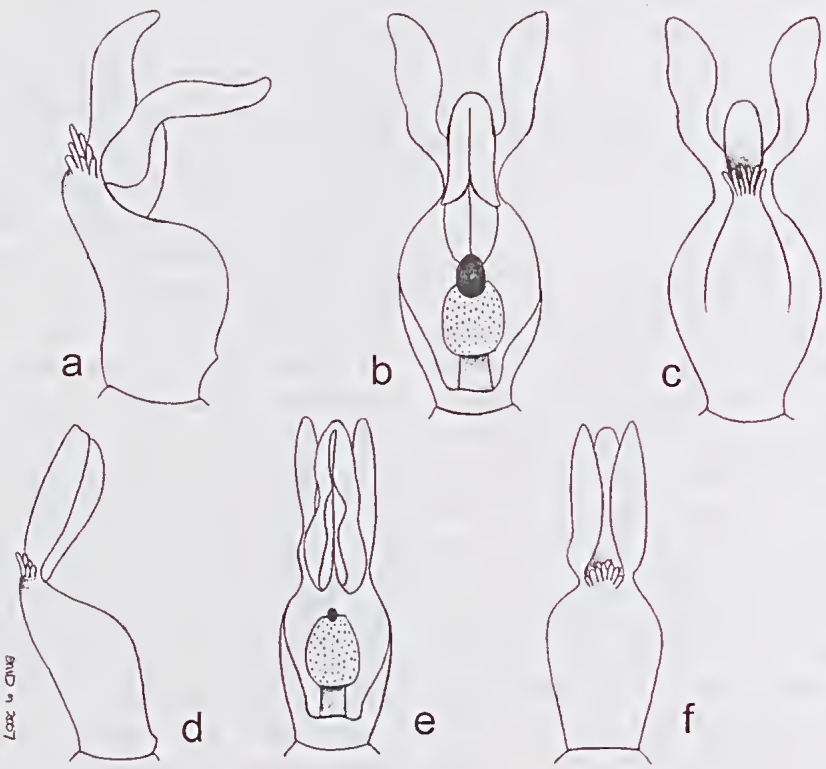

Figure 12. *Thelymitra speciosa*: **a** column from side ×5; **b** column from front ×5; **c** column from rear ×5. *Thelymitra pulcherrima*: **d** column from side ×5; **e** column from front ×5; **f** column from rear ×5.

8. *Thelymitra pulcherrima* Jeanes, *sp. nov.*

Thelymitra. variegatae (Lindl.) F.Muell *affinis sed floribus minoribus praecocibus, sepalis et petalis colorum diversorum et habitatione septentrionali differt.*

Type: Western Australia. Eneabba–Leeman Rd, 6–7 km W of the Brand Highway, 26.viii.2001, *C.J. French 2947* (holotype PERTH, isotypes MEL 2136734 & CANB).

Illustrations: Hoffman and Brown (1998) page 456 (as *T.* aff. *variegata*); Jones (2006) page 255; Brown *et al.* (2008) page 323.

Virtually glabrous, somewhat glaucous terrestrial *herb*. *Tubers* not seen. *Leaf* ovate-auriculate at base, narrowing abruptly and linear to linear-lanceolate above, 5–10 cm long, 4–10 mm wide, erect, almost straight to somewhat spirally twisted, canaliculate, fleshy, dark green with a purplish base, sheathing at base where margins often lobed and undulate, pubescent towards base with hairs mostly on veins and margins, apex subacute. *Inflorescence* 10–30 cm tall, more or less straight. *Scape* 0.5–1.5 mm diam., wiry, green or purplish. *Sterile bract* solitary, lanceolate to ovate, 10–35 mm long, 3–8 mm wide, green or purplish, closely sheathing at base, apex diverging from scape, acute to acuminate. *Fertile bracts* ovate to obovate, 5–15 mm long, 3–8 mm wide, green or purplish, sheathing the pedicels, margins connate at base, apex acute to acuminate. *Pedicels* 5–15 mm long, slender. *Ovary* narrow-obovoid, 5–10 mm long, 1.5–4 mm wide, curved. *Flowers* 1–6, 25–35 mm diameter, with sepals and petals of contrasting colour, glossy, opening freely in warm weather. *Perianth segments* 10–18 mm long, 2.5–8 mm wide, concave to almost flat, stiffly spreading; *dorsal sepal* ovate to ovate-lanceolate, acute to subacute, usually broader than other segments, central part purplish, edges yellow with strong reddish brown markings; *lateral sepals* lanceolate to linear-lanceolate, often slightly asymmetric, acute to acuminate, mostly yellow with strong reddish brown markings; *petals* lanceolate to linear-lanceolate, often slightly

asymmetric, acute to acuminate, mostly purplish with darker veins and blotches; *labellum* lanceolate to linear-lanceolate, acute to acuminate, smaller than other segments, mostly purplish with darker veins and blotches. *Column* erect from the end of ovary, 5–7 mm long, 3–5 mm wide, broadly winged, similarly coloured to petals; *post-anther lobe* vestigial, not hooding the anther, 0.4–0.7 mm long, apical margin covered with an arc of digitate to subglobose glands 0.4–1 mm long; *auxiliary lobes* absent; *lateral lobes* parallel or diverging slightly, oblong to elliptic, 4–5.5 mm long, 1–1.5 mm wide, straight to shallowly s-shaped, erect or obliquely erect, stipitate, fleshy, rugulose, yellow or orange. *Anther* inserted near apex of column, obloid, 5–6 mm long, 1.5–2 mm wide, projecting forward at about 45° to column, yellow or orange, the connective produced into a fleshy beak 2–3 mm long, surface papillate, ventral surface channelled; *pollinarium* 2.5–3.5 mm long; *viscidium* elliptic, c. 0.7 mm long, c. 0.6 mm wide; *pollinia* coherent, cream. *Stigma* situated c. midway along column, orbicular to transversely broad-elliptic, 2–3 mm long, 1.5–2 mm wide, concave, margins irregular. *Capsules* not seen. (Fig. 9, Fig. 12 d–f)

Specimens examined: **WESTERN AUSTRALIA**: 3 km SW of Mt Lesueur, 24.vii.1969, *K.M. Allan 64* (PERTH 278718); Watheroo, 2.viii.1971, *Mrs Scott s.n.* (PERTH 27B645).

Distribution and habitat: Endemic to south-west Western Australia, between Lancelin and Dongara. Grows in open areas among shrubs in laterite soils or rarely sandy soils. Altitude: 10–100 m.

Conservation status: Apparently very rare and seldom collected, but moderately widespread and conserved. Suggest 3VC by criteria of Briggs and Leigh (1996) and Vulnerable (VU) by criteria of IUCN (2001).

Flowering period: June to early September.

Pollination biology: The large, freely opening flowers, functional viscidium, coherent pollen and sporadic production of seed capsules would indicate that this species is primarily entomophilous.

Notes: *Thelymitra pulcherrima* is most closely related to *T. apiculata*, *T. speciosa* and *T. variegata*. It can be distinguished from *T. speciosa* by its capacity to produce up to six relatively small flowers, from *T. variegata* by its generally smaller flowers whose sepals and petals are of strongly contrasting colour (the sepals predominantly yellow with reddish brown blotches and the petals predominantly purple with darker veins and blotches) and from *T. apiculata* by the lateral lobes of the column that are not apiculate at the apex.

Etymology: Latin *pulcher*, beautiful; this is a very spectacular and showy species.

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Fellhaneropsis pallidonigrans, a south-eastern Australian lichen

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Abstract

The new combination, *Fellhaneropsis pallidonigrans* (Müll.Arg.) Kantvilas & Lücking, is introduced for a common lichen from cool temperate rainforests in Tasmania and Victoria. This taxon is described in detail and compared with related and superficially similar species.

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Introduction

The genus *Fellhaneropsis* Sérus. & Coppins was introduced in Sérusiaux (1996) to accommodate two distinctive species of crustose lichens from the family Pilocarpaceae. Like the closely related *Fellhanera* Vězda, *Fellhaneropsis* has *Byssoloma*-type asci, branched and anastomosing paraphyses, and hyaline, transversely septate, narrowly ellipsoid-fusiform to acicular ascospores; it differs chiefly by having ± immarginate apothecia with an excipulum of prosoplectenchymatous (rather than paraplectenchymatous) hyphae, and filiform, sigmoid macroconidia (Lücking 2008). The description of the new genus inspired a review of other superficially similar taxa or collections and, as a result, further additions to the genus have since been made by Thor *et al.* (2000) from Japan, Lücking *et al.* (2001) from Australia, and Øvstedal and Gremmen (2006) from Heard Island.

Studies of type material of Australian lichens have revealed an overlooked name for a further species of the genus that is widespread in cool temperate rainforests of south-eastern Australia. The appropriate new combination is introduced here, and a full description and discussion of the taxon, based on recent collections, is provided.

Material and methods

The study is based on material housed in the Tasmanian Herbarium (HO) and the National Herbarium of Victoria (MEL). Anatomical investigations were conducted on hand-cut sections of thalli and apothecia mounted in water, 10% KOH, concentrated HNO_3, lactophenol cotton blue and Lugol's iodine. Measurements of ascospores and asci are based on at least 50 observations and are presented in the following format: lowest value–*mean*–highest value. Chemical constituents were identified routinely by thin-layer chromatography using standard methods (Culberson & Ammann 1979; Culberson & Johnson 1982). Nomenclature of ascus types follows Hafellner (1984).

Comparative material examined: *Fellhaneropsis australiana* Lücking: **AUSTRALIA: NEW SOUTH WALES.** Rutherfords Creek, Brown Mountain, 36°35′22″S 149°26′44″E, 815 m alt., 17.iv.2008, *P.M. McCarthy 2637* (CANB, HO). *Fellhaneropsis myrtillicola* (Erichs.) Sérus. & Coppins:

Royal Botanic Gardens Melbourne

FRANCE. Bayonne, valle d'Esboue, 10.iv.1996, *J. Vivant*, A. Vězda: Lich. Rar. Exsicc. 343 (HO).

Taxonomy

Fellhaneropsis pallidonigrans (Müll.Arg.) Kantvilas & Lücking *comb. nov.*

Patellaria pallidonigrans Müll.Arg., *Bull. Herb. Boissier* 1: 49 (1893); *Bacidia pallidonigrans* (Müll.Arg.) Zahlbr., *Cat. Lich. Univ.* 4: 134 (1926).

Type: Victoria. On tree, Warburton, December 1885, *F.R.M. Wilson 769* (holotype, *fide* Filson 1986: G; isotype: MEL 7173!).

Thallus pale yellowish, yellowish green or greenish, initially composed of scattered, irregular areoles over a prothallus, soon fusing and forming an effuse, smooth crust, tightly encrusting the bark substratum and any adjacent or underlying bryophytes, continuous to patchy, rather glossy, ecorticate, 25–70(–100) µm thick; prothallus dull grey to black, effuse, usually clearly evident at the thallus margins or in more patchy, central parts of the thallus. *Photobiont* a thin-walled, unicellular green alga of the 'micareoid'-type (after Coppins 1983), with globose cells (4–)6–9 µm diam.

Apothecia typically very numerous and scattered, 0.2–0.5 mm wide, roundish, milky-fawn to pale yellow-brown to dark grey-brown, not infrequently mottled-piebald, broadly adnate to slightly basally constricted, immarginate, or with an indistinct proper margin ± slightly paler than the disc, visible in the youngest apothecia but soon excluded; disc plane to convex, epruinose. *Excipulum* in section colourless, poorly developed, reflexed, to 30 µm thick, soon ± excluded, composed of radiating, branched, conglutinated hyphae 1–3 µm thick with elongate lumina. *Hypothecium* colourless to pale yellowish, K± pale yellowish, 60–120 µm thick, composed of entangled hyphae. *Hymenium* colourless, 40–55 µm thick, IKI+ intense blue, sometimes with a pale yellowish brown epihymenial layer, in dark coloured apothecia with a patchy, greenish, K± olive-green, N+ reddish brown epihymenial pigment. *Asci* elongate clavate, 8-spored, 35–*41.3*–55 × (9–)10–*12.5*–15(–18) µm, approximating the *Byssoloma*-type; i.e. tholus well-developed, amyloid, with a more intensely amyloid, albeit rather indistinct, ring structure. *Paraphyses* indistinct, rather sparse, highly conglutinated, branched, especially in the upper part, 0.8–1.5 µm thick; apices slightly expanded to 2–3 µm, especially in pigmented apothecia. *Ascospores* colourless, non-halonate, fusiform-ellipsoid, straight or slightly bent, (2–)3(–4)-septate, 11–*15.0*–18(–20) × (3–)3.5–*4.2*–5 µm; apices ± acute or blunt. *Pycnidia* not found. *Chemistry:* gyrophoric acid; thallus and apothecial squashes C+ red. (Figs 1, 2)

Remarks: *Fellhaneropsis pallidonigrans* is a distinctive lichen, characterised by its pale coloured, widely spreading thallus that often forms ± continuous patches to 30 cm wide, the very abundant, pale to dark coloured, often piebald apothecia, the *Byssoloma*-type asci and the 3-septate, fusiform ascospores. It is found almost exclusively in cool temperate rainforest of the callidendrous type (nomenclature after Jarman *et al.* 1994), a forest type with a closed canopy of tall, well-formed dominant trees (usually *Nothofagus* Blume and or *Atherosperma* Labill.) and a relatively open understorey dominated by ferns including tree ferns (*Dicksonia* L'Hèr. or *Cyathea* Sm.). There this lichen occurs in deep shade on bark. A particularly characteristic habitat is the exposed large roots of forest trees that form cage-like frames on or just above the ground. The species is clearly very fast growing and encrusts living mosses and hepatics in its path.

In Tasmania, this species has for many years been considered to be an unidentified species of *Micarea* Fr. on account of its ± immarginate apothecia, transversely septate, fusiform ascospores, and thallus chemistry. Indeed, its resemblance with respect to these characters to certain species of that genus, notably to *M. peliocarpa* (Anzi) Coppins & R.Sant. and its relatives, *M. alabastrites* (Nyl.) Coppins and *M. cinerea* (Schaerer) Hedl., is remarkable. However, the *Micarea* taxa can be distinguished by having different asci (*Micarea*-type, with a well-developed, amyloid tholus pierced completely by a non-amyloid, narrow masse axiale); they also have more abundant paraphyses that are lax in KOH, an exciple composed of anastomosing hyphae, and apothecia that are more basally constricted to often tuberculate. Interestingly, the correct affinities of *F. pallidonigrans* to the Pilocarpaceae were noted first by Müller (1893) who, in the original description, compared it with *Lecidea chloroplaca* Fée [= *Byssoloma leucoblepharum* (Nyl.) Vain. (Santesson 1952)].

Within the genus itself, *Fellhaneropsis pallidonigrans* occupies a rather outlying position. None of the

other species are known to contain secondary lichen substances (Lücking 2008). Furthermore, the other known species, although morphologically similar, tend to have a far less robust and therefore less conspicuous thallus. Whereas *F. australiana* Lücking and *F. kurokawae* G.Thor, Lücking & Tat. Matsumoto are foliicolous, *F. subantarctica* Øvstedal is terricolous over bryophytes and *F. vezdae* (Coppins & James) Sérus. & Coppins and *F. myrtillicola* (Erichs.) Sérus. & Coppins are known to colonise bark, rock and leaves. The ascospores of *F. pallidonigricans* are similar to those of *F. myrtillicola* and *F. kurokawana*, although slightly smaller. Nevertheless, on the basis of apothecial anatomy, ascus type and ascospore morphology, *Fellhaneropsis* is considered to be the most appropriate position for this species.

***Selected specimens examined*: AUSTRALIA: TASMANIA:** West of Tahune Bridge in the Warra SST, 43°06'S 146°41'E, 180 m alt., 25.i.2000, *G. Kontvilos 55/00* (HO); Anthony Raad, 41°50'S 145°38'E, 600 m alt., 10.v.1991, *G. Kantvilos 242/91* (CANB, HO); West Takone, 470 m alt., 21.i.1082, *G. Kantvilas 11/B2* (BM, HO); near Piney Creek, 41°50'S 145°14.5'E, 350 m alt., 7.iv.1989, *G. Kontvilas 147/89* (HO); Murchison Hwy, c. 4 km E of Mt Black, 41°46'S 145°36'E, 360 m alt., 18.iii.2008, *G. Kontvilos 70/0B* (F, HO). **VICTORIA:** Tarra-Bulga NP, Cyathea Falls, 38°26'47"S 146°32'19"E, 250 m alt., 14.iv.2008, *G. Kantvilos 94/0B & J.A. Elix* (HO, MEL); Errinundra Plateau, Bonang River Picnic Area, 37°17'02"S 148°48'25"E, 810 m alt., 16.iv.2008, *G. Kantvilas 129/0B, J. Elix & P. McCorthy* (HO, MEL).

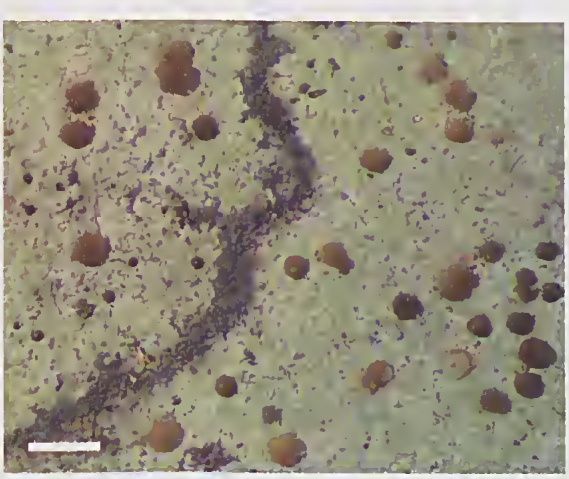

Figure 1. Habit of *Fellhoneropsis pallidonigrans* (*Kontvilos 70/0B*). Scale = 1 mm.

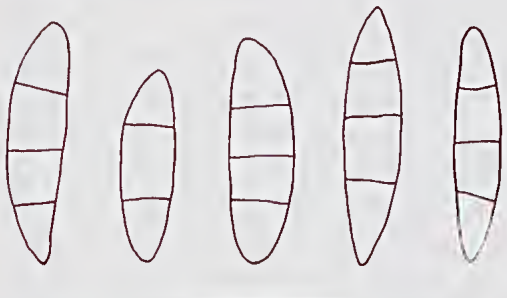

Figure 2. Ascaspares of *Fellhanerapsis pallidonigrons* (*Kantvilas 70/0B*). Scale = 10 µm.

Acknowledgement

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A new subspecies of *Stylidium armeria* (Stylidiaceae) from the Macedon Range, Victoria

a253/92

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Abstract

A new subspecies of *Stylidium armeria* (Labill.) Labill., apparently confined to dry heathy vegetation on skeletal shaly soils in the southern foothills of the Macedon Range near Riddells Creek and the Pyrete Range, is described as *S. armeria* subsp. *pilosifolium* R.J.Best, D.E.Francis & N.G.Walsh. It is illustrated and its ecology and conservation status are discussed. A revised key to the members of the *S. graminifolium* Sw. complex in Victoria is provided. The new subspecies is remarkable for the indumentum of copious glandular and eglandular multicelluar hairs and short unicellular papillae on the leaf lamina, and its generally smaller morphology.

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Introduction

In the course of recent surveys of the southern foothills of the Macedon Range (Best & Francis 2008), a few populations of a previously unknown member of the *Stylidium graminifolium* complex (*sensu* Raulings & Ladiges 2001) of uniform anatomy and similar habitat were discovered. Consultation with recent published treatments (Raulings 1999; Jackson & Wiltshire 2001; Raulings & Ladiges 2001) and with specimens at the National Herbarium of Victoria (MEL) has led to the conclusion that these populations represent a new, previously uncollected, entity related to *Stylidium armeria*. The opportunity is taken here to describe this new subspecies.

Taxonomy

Stylidium armeria* subsp. *pilosifolium* R.J.Best, D.E. Francis & N.G. Walsh, *subsp. nov.

A subspecie armeria *(Labill.) Labill. foliis breviore pilosis in paginis ambabus differt*

Type: Victoria. Riddells Ck, Barrm Birrm, between Princess St and Prince Alfred St, 14.xi.2007, *D.E. Francis 4* (holotype: MEL 2323797; isotypes: CANB, HO, PERTH).

Perennial herb 15–40 cm high, often shortly rhizomatous. *Plants* solitary or in clumps usually of 2–5 tufts. *Leaves* all basal, erect to spreading, oblanceolate, typically 5–11 cm long, 4–8 mm wide (rarely smaller), both surfaces and margins pilose, especially margins and midrib on undersurface, pale green; hairs multicellular, to c. 1 mm long, with cells in 2 columns below the glandular or eglandular tips, unicellular papillae abundant on the adaxial surface and abaxial midrib, absent or very sparse elsewhere on the abaxial surface; margins entire; apex acute. Stomata adaxially confined to narrow (0.1–0.2 mm wide) bands bordering the midrib, or sometimes apparently absent, abaxially evenly

distributed between the midrib and margin. *Scape* 10–25 cm high, less than 2 mm diameter, moderately to densely glandular-pubescent; *inflorescence* a simple, erect raceme 5–15 cm long; *flowers* 5–30 per raceme. *Calyx* narrowly ovoid-cylindrical, 2–3.5 mm long, glandular-pubescent, 2-lipped, each lip ±obcordate and comprising 2 largely fused lobes, free for only c. 0.5 mm; *corolla* 8–10 (–12) mm across, white or pale pink, abaxially lightly glandular-pubescent, lobes paired laterally, obovate, not equal, the posterior lobes longer and wider than anterior pair; *labellum* broadly ovate, 2–3 mm long, obtuse to acute, paired lateral appendages filiform, c. 1 mm long; *throat appendages* 8, the 6 anterior appendages prominent, ±equal, 1–2 mm long, densely papillate with white, yellow or red papillae, the 2 posterior throat appendages each reduced to a papillate or colliculate mound on the petal; *column* 7–9 mm long, the flexion zone thickened c. 3 mm from base, and the distal part inflexed c. 2 mm below the anther-stigma complex; anthers dark-rimmed, pollen white; stigma orbicular, with short glands. *Capsule* ovoid-globose, 5–8 mm long; seeds angular-ovoid, c. 1 mm long, crimson to reddish-brown with a small, pale, apical caruncle. Figs 1A, 2.

***Specimens examined*: VICTORIA.** Riddells Ck, c. 3.5km N of town centre, 4.xi.2007 *N.G. Walsh 6722* (MEL 2314295).

***Distribution and habitat*:** *Stylidium armeria* subsp. *pilosifolium* is apparently endemic to the foothill forests at the south-eastern extreme of the Macedon Range and in the Pyrete Range. It is currently known from only six discrete populations in the Riddells Creek–Barringo area in the Mt Robertson Range, and one population in the nearby Pyrete Range c. 11 km to the south-west. It occurs at altitudes between 450 and 600 m a.s.l. The local average annual rainfall is c. 760 mm. The habitat is generally grassy or heathy woodland in foothill forest largely devoid of medium or large shrubs, and with a sparse ground layer usually with considerable areas of bare soils. Fig. 1B.

Two vegetation types (EVCs sensu DSE 2004) have been identified containing *S. armeria* subsp. *pilosifolium*. (1) Heathy Dry Forest consisting of a low heathy woodland dominated by stunted *Eucalyptus dives* Schauer and *E. cephalocarpa* Blakely over bare shaly ground dominated

Figure 1A. *Stylidium armeria* subsp. *pilosifolium* plants *in situ* at Riddells Creek; **1B.** Low heathy woodland at Riddells Creek with stunted *Eucalyptus dives* to c. 5 m high on skeletal, shaly ground.

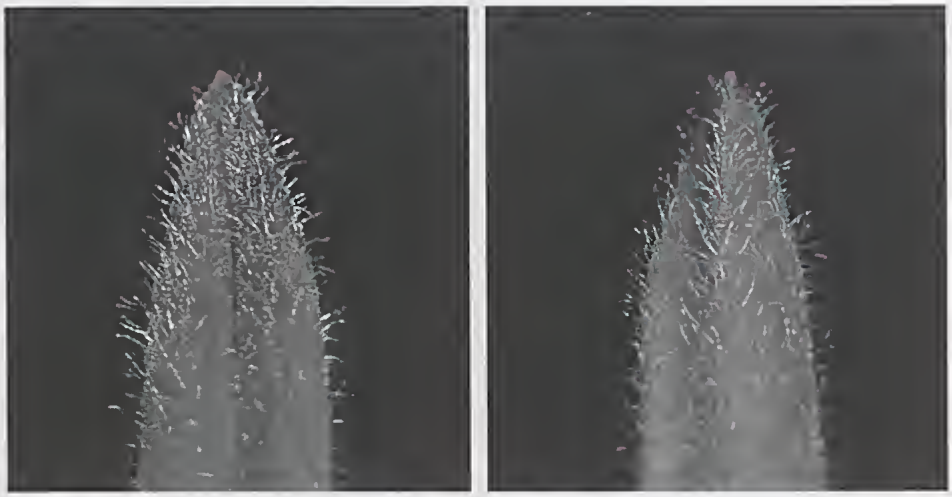

Figure 2. Adaxial (left) and abaxial (right) leaf surfaces of *S. armeria* subsp. *pilosifolium* (from plants cultivated at Royal Botanic Gardens Melbourne).

by *Poa sieberiana* Spreng., heaths (e.g. *Monotoca scoparia* (Sm.) R.Br., *Leucopogon virgatus* (Labill.) R.Br.), other low woody shrubs (e.g. *Cryptandra amara* Sm., *Acacia gunnii* Benth., *Podolobium procumbens* (F.Muell.) Crisp & P.H.Weston, *Dillwynia sericea* A.Cunn.), *Xanthorrhoea australis* R.Br., stunted *Lepidosperma laterale* R.Br. and *Lomandra filiformis* (Thunb.) Britten, and geophytes (e.g. *Glossodia major* R.Br., *Diuris sulphurea* R.Br., *Burchardia umbellata* R.Br.). (2) Grassy Dry Forest on and around dry spurs in foothill forests dominated by a mix of eucalypts (*Eucalyptus obliqua* L'Her., *E. cephalocarpa*, *E. dives* and *E. aromaphloia* L.D.Pryor & J.H.Willis) and an understorey of stunted shrubs (e.g. *Dillwynia sericea*, *Grevillea alpina* Lindl., *Correa reflexa* (Labill.) Vent.), *Xanthorrhoea australis*, a ground layer of perennial graminoids (e.g. *Joycea pallida* (R.Br.) H.P.Linder, *Poa sieberiana*, *Dianella admixta* Gand.) and forbs (e.g. *Brunonia australis* Sm. ex R.Br. and *Coronidium scorpioides* (Labill.) Paul G. Wilson).

The soils are shallow to skeletal yellow duplexes derived from metamorphosed Ordovician sandstones, locally incorporating rounded river stones, providing the regionally distinctive 'conglomerate' rock for which the Conglomerate Gully Reserve in Riddells Creek is named (L. Milne pers. comm.).

Conservation Status: More than 90% of the known population of this plant is restricted to an area known as Barrm Birrm, the side of the Mt Robertson Range that overlooks Riddells Creek. This area is not reserved. It is estimated that this area may contain about 500 plants, mostly along three dry spurs. Only five other occurrences of the plant have been recorded, with just a few dozen plants at each of these locations, namely, three other areas in the Robertson Range – Conglomerate Gully Reserve, managed by Parks Victoria; Barringo Reserve, managed by Macedon Ranges Shire Council; Mt Teneriffe, managed by Trust for Nature; and on private land on Mt Robertson – and one small patch in the Pyrete Range near Gisborne. At each of these sites it is highly restricted with the largest patch about 100 m x 30 m. A local form of *Stylidium armeria* subsp. *armeria* is often found in proximity to (but never truly contiguous with) *S. armeria* subsp. *pilosifolium*. It occurs on slightly deeper soils in the moister valley/depressions between the drier spurs that support the new subspecies. In these areas *S. armeria* subsp. *armeria* has white to pale pink flowers and leaves always less than 20 cm long, features that deviate from the key in Raulings and Ladiges (2001) for *S. armeria* (see 'notes' below). Seedling trials at the Royal Botanic Gardens Melbourne, comprising over 30 plants of both subspecies, grown from seed collected at and near the type locality for *Stylidium armeria* subsp. *pilosifolium*, produced progeny with the same characteristics as the parent plants; i.e. *S. armeria* subsp. *pilosifolium* seedlings produced short, distinctly pilose leaves whereas subsp. *armeria* seedlings had longer, relatively narrower leaves with sparse hairs confined to the margins. Adult plants of subsp. *pilosifolium* retain the short, hairy leaf character whereas subsp. *armeria*

plants soon become glabrous and produce longer leaves. Another, apparently typical, form of *Stylidium armeria* subsp. *armeria* with leaves 20–30 cm long is also found elsewhere in the general vicinity, but separated from the aforementioned populations (e.g. at higher altitudes in Riddells Creek and Mt Macedon). *Stylidium graminifolium* also occurs in the vicinity (e.g. at Riddells Creek Cemetery) on deeper soils supporting remnant grassland dominated by *Themeda triandra* Forssk.

We suggest a conservation status of Critically Endangered (*sensu* IUCN 2001). The major threat is probably destruction of habitat by human activity and residential development. The largest populations are in areas that offer unrestricted public access and are used by off-road vehicles (motorbikes and 4WDs) and horse riders. Being at the bushland-urban interface, rubbish dumping including garden refuse occurs around the largest populations, leading to the likelihood of invasion by horticultural weeds.

Etymology: The epithet *pilosifolium* (Latin *pilosus* – pilose; *folium* – leaf) refers to the most obvious characteristic separating this from other members of the *S. graminifolium* complex.

Notes: The new subspecies differs from typical *S. armeria* in having generally shorter leaves that are densely pilose on both surfaces, usually more densely so on the margins and on the abaxial midrib. As well as these longer hairs, the adaxial leaf surface and the abaxial midrib bear short, unicellular, eglandular papillae. The latter are rare on typical *S. armeria*. The composition of the overall indumentum is apparently unique in *Stylidium* (J. Wege, PERTH, pers. comm.). It has generally shorter, fewer-flowered inflorescences. The flowers are generally smaller than those of typical subsp. *armeria*. The flowers are also white to pale pink, a feature that differs from the treatment by Raulings and Ladiges (2001) for typical *S. armeria* but which is also a feature of some short-leaved forms of subsp. *armeria* that we have collected nearby in Riddells Creek (MEL 2323796) and in similar dry heathy forest in ranges to the north-east of Melbourne, e.g. near Kinglake (MEL 670177, 2314297) and Toolangi (MEL 2323829). This form has leaves <20 cm long that are glabrous or, rarely, sparsely glandular-pilose on the margins and/or abaxial midrib only. A single plant observed at Riddells Creek in summer 2007 appeared to be intermediate in character betwen subsp. *pilosifoium* and the short-leaved form. Seeds were collected from this plant and germinants were grown on at the Royal Botanic Gardens Melbourne nursery. There was clear segregation of the cohort of seedlings into hairy- and glabrous-leaved plants, and these characters were retained to maturity, supporting the notion that the parent plant was a hybrid between the two subspecies. No other apparent hybrids were observed then or since.

The characters used to separate the two subspecies of *S. armeria* here are of comparable taxonomic value to those used to separate other species in the *Stylidium graminifolium* complex as outlined by Raulings and Ladiges (2001). In fact there is considerable overlap of characters in the taxa dealt with by Raulings and Ladiges (*op. cit.*), whereas *S. armeria* subsp. *pilosifolium* is immediately distinguished from the other members of this complex by its hairy mature leaves.

On the basis of this assessment, a case could be made to recognise subsp. *pilosifolium* at species rank but we prefer to make obvious what we believe to be the closer relationship to *S. armeria* than to other members of the complex and recognise it at subspecific rank.

We provide a revised key to the complex as it occurs in Victoria, taking into account the new entity and a reassessment of characters used in previous keys (e.g. Raulings 1999; Raulings & Ladiges 2001; Wiltshire & Jackson 2001) based on our observations of herbarium specimens and living plants *in situ*. We do not recognise *S. dilatatum* W.D.Jacks. & R.J.E.Wiltshire as a member of the Victorian flora and believe specimens previously referred to that species in Victoria belong to the variable *S. armeria* subsp. *armeria*.

Acknowledgements

We are grateful to Chris Jenek (Royal Botanic Gardens Melbourne) who grew and maintained the plants used in the seedling trials, to Lachlan Milne (Environment Resource Officer, Macedon Ranges Shire Council) for information on soil characteristics and geology of the habitat for the new subspecies and to Juliet Wege (PERTH) for her helpful comments regarding the distinctness and appropriate taxonomic status of the plant.

A revised key to the *Stylidium graminifolium* complex:

1	Leaf width <3 mm, more or less linear	2
1:	Leaf width ≥3 mm or, if <3 mm, then leaf narrowly oblanceolate to oblanceolate	3
2	Flowers white to pale pink; plants generally not or only weakly rhizomatous; mainly sandy or clay soils from near sea-level to c. 500 m a.s.l.	*S. graminifolium*
2:	Flowers deep pink to magenta; plants typically strongly rhizomatous and forming compact clumps of up to c. 50 crowns; restricted to peaty soils of montane to sub-alpine areas	*S. montonum*
3	Longest leaf (2–)5–40 cm, if longest leaf ≤11 cm then pilose; plants usually solitary (but often rhizomatous with 2–5 crowns in subsp. *pilosifolium*); widespread from the coast to the subalps	4 (*S. armeria*)
3:	Longest leaf 2–12 cm, glabrous; plants typically strongly rhizomatous and forming compact clumps of up to c. 50 crowns; restricted to moist, peaty soils of sub-alpine and alpine areas	*S. montanum*
4	Leaf glabrous on both surfaces or, rarely, with a few, widely spaced glandular hairs on margins and/or abaxial midrib, and these usually present only on juvenile plants; longest leaf (10–)12–40 cm long, leaf length/width ratio mostly >18; flowers mostly deep pink to magenta (rarely pale pink or white); widespread in diverse habitats from the coast to the subalps	subsp. *armeria*
4:	Leaf pilose with eglandular and glandular hairs on both surfaces and margins; longest leaf 11 cm long or less, leaf length/width ratio <18; flowers white to pale pink; apparently restricted to dry, shaly soils in foothills at the southern end of the Macedon Range near Riddells Creek and the nearby Pyrete Range	subsp. *pilosifolium*

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A new species of *Pultenaea* (Fabaceae) from central Victoria

a253193

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Abstract

A new species, *Pultenaea dargilensis* Corrick & N.G.Walsh is proposed for a geographically restricted entity from near Heathcote in central Victoria, which until now has been referred to *P. pedunculata* Hook. The new species is described and illustrated, and its habitat and conservation status discussed. The typification of *Pultenaea pedunculata* var. *pilosa* H.B.Will. is clarified.

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Introduction

Pultenaea pedunculata is typically a mat-forming shrub with axillary flowers usually borne singly on slender pedicels clearly exceeding the subtending leaf. Its leaves are typically narrowly elliptic, 4–13 mm long, darker on the upper surface with stomata confined to the lower surface, and the margins are recurved. The calyces and leaves, at least when young, are hairy with ascending to antrorsely appressed hairs. It is scattered through usually dry open forest from southern New South Wales, through central Victoria, extending to south-east South Australia and Tasmania. It belongs to section *Eupultenaea* of Bentham (1864), Group IX of Sands (1975) and 'the eastern species with recurved leaves' of de Kok and West (2004).

H.B. Williamson (1922) wrote at length about the variation in *Pultenaea pedunculata* Hook., giving reasons for including *P. ausfeldii* Regel as a synonym. In the same work he erected two new varieties, var. *latifolia* H.B.Will., based on material collected from Port Lincoln, South Australia, and var. *pilosa* H.B.Will., based on material collected from Chewton, central Victoria. De Kok and West (2004) indicated that the type of var. *pilosa* was at MEL. However at that point there were no specimens of *P. pedunculata* at MEL explicitly noted as being collected from Chewton. A fragment, previously amongst Williamson's extensive handwritten notes on *Pultenaea*, has been found and is now mounted as a type (MEL 648096). It is annotated in Williamson's hand as 'var. *pilosa*' and it accords with other specimens of *P. pedunculata* at MEL collected from the general vicinity of Chewton in the calyces, pedicels and at least younger stems with sparse to moderately dense, ascending to antrorsely appressed hairs. Williamson's diagnosis for var. *pilosa* gave '*calyce et pedunculis sericeo-pilosis, foliis paulo recurvatis*', features present on MEL 648096. It is reasonable to suppose this is in fact Williamson's type. There appear to be no isotypes at MEL or in other herbaria.

We concur with Thompson (1961) and de Kok and West (2004) in regarding var. *pilosa* as part of the continuous variation to be found within *P. pedunculata* which has the calyces and pedicels quite glabrous to moderately densely covered with antrorse to forwardly appressed

hairs. Similarly, Williamson's var. *latifolia*, with relatively broad leaves, long calyx lobes, long pedicels and occurring mainly in the western part of the species' range isn't clearly distinguishable.

Mounted as possible types of *P. pedunculata* var. *pilosa* at MEL are two (presumed) 1861 collections of H. Beckler's from the Pyalong area ('Road to Pyalong', MEL 2156648; 'Hill near Pyalong', MEL 2156649). These too have been annotated, apparently by Williamson, as 'var. *pilosa*', but the indumentum of the calyces, pedicels and stems is dense and spreading, or sometimes on the stems, somewhat retrorse, certainly not sericeous, and generally quite distinct from the indumentum to be found on the 'Chewton' type or any other material of *P. pedunculata* across its geographic range. Although Williamson annotated the Beckler collections he apparently did not observe the difference in the indumentum. As there are no Williamson collections at MEL that match the fragmentary Beckler specimens, it could be assumed that he did not himself collect from the same population, otherwise one would expect him to have noticed the very obvious differences in habit and generally dull green appearance of the foliage, compared with the distinctive bright green of typical *P. pedunculata*.

We have located a population of plants matching those represented by the Beckler Pyalong collections in the Dargile State Forest, near Heathcote, and approximately 28 km NNW from Pyalong. The plants in this population are uniform in habit, and rather than dense and ground-hugging which is the typical habit for *P. pedunculata* (giving rise to the common name 'matted bush-pea'), are finally loosely decumbent or procumbent, or when young weakly erect. The foliage, almost grass-green and often sub-lustrous in typical *P. pedunculata*, is dull grey-green in the Dargile Forest plants. We believe these plants to be sufficiently distinct to warrant taxonomic recognition. We do not believe they form part of an entity represented by Williamson's diagnosis or type specimen of var. *pilosa* and consequently we reject the Beckler collections as type material of that entity. We regard the combined

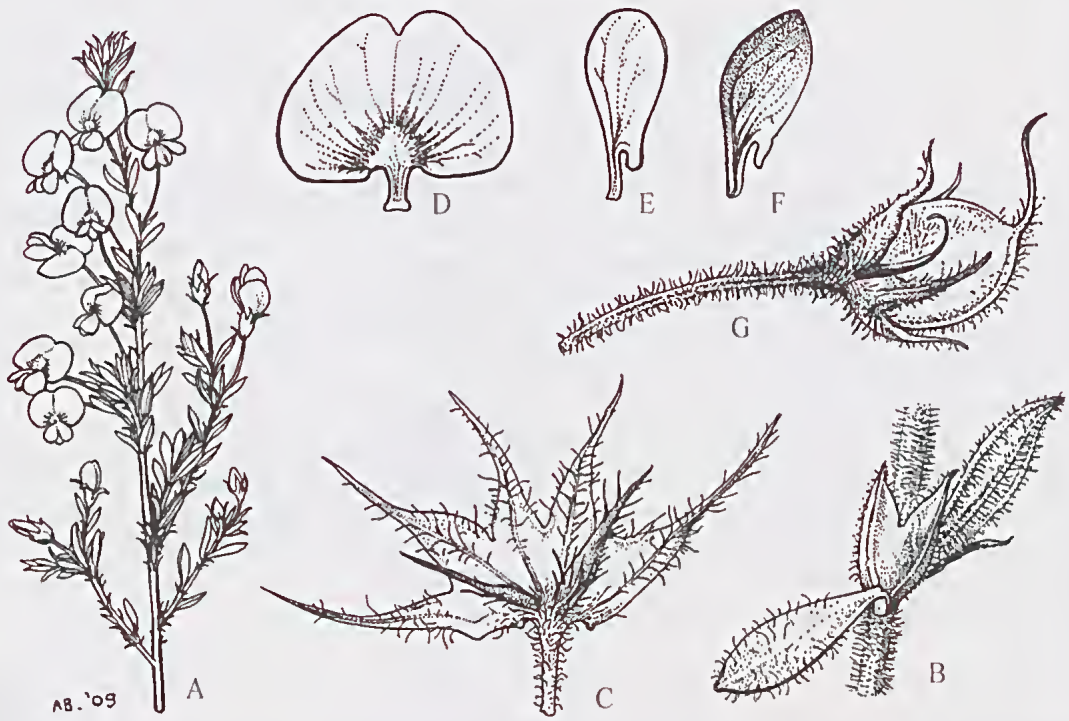

Figure 1. *Pultenaea dargilensis*: **A.** flowering twig x1; **B.** section of stem with leaves and stipules x 6; **C.** calyx with bracteoles x6; **D.** standard x4; **E.** wing petal x4; **F.** keel petal x4; **G.** young pod x5. A-F from *Corrick 11609* (MEL); G from *Corrick 11610* (MEL).

differences in habit and indumentum as being sufficiently distinct to recognise these plants as a distinct species.

Taxonomy

Pultenaea dargilensis **Corrick & N.G.Walsh,** *sp. nov.*

A P. pedunculata *habitu non prostrata, et indumento calycum pedicellarum et ramulorum denso et patento vel retrorso differt.*

Type: Victoria: Dargile State Forest, 7 km NNE of Heathcote, 14.x.2001, *M.G.Corrick 11609*. (holotype MEL; isotype CANB).

Loosely decumbent or procumbent *shrub* to c. 30 cm high and to c. 60 cm diam. Indumentum of *stems* spreading to somewhat retrorse with hairs in 2 size classes, c. 0.1 mm and 0.5 mm long. *Stipules* lanceolate, 2–2.5 mm long, initially connivent in proximal 1/3. *Leaves* narrowly elliptic to oblanceolate, 4–8 mm long, 1–1.8 mm wide, initially densely pilose with fine spreading hairs to c. 1 mm long, glabrescent, but older leaves usually retaining some hairs at least on the abaxial surface; adaxial surface finally minutely tuberculate; margin plane to slightly recurved; midrib prominent on abaxial surface; mucro to 0.8 mm long, straight or very slightly decurved. *Pedicels* 5–10 mm long, densely indumented with short, spreading hairs. *Bracteoles* linear, 3–4 mm long, pilose; *calyx* 4–5 mm long, prominently 5-nerved, densely covered throughout with spreading hairs 0.5–1 mm long; *lobes* narrow-subulate, 3–3.5 mm long; *standard* 6–7 mm long at anthesis, orange with red to brown basal flare, wings orange, keel wholly red to brown. *Pod* broad-elliptic, c. 5 mm long, 4 mm wide, shortly and evenly pilose. *Seeds* 1 or 2, reniform, c. 2 mm long. Figs 1, 2.

***Specimens examined*: VICTORIA.** Hills near Pyalong, 6.x.1861, *H. Beckler 100* (MEL); Road to Pyalong, 6.x.1861, *H. Beckler* 6 (MEL); Dargile Reserve, 27.ix.1987, *P.C. Jobson 119* (MEL); Dargile State Forest, 18.x.2003, *N.G. Walsh 5860* (CANB, MEL, NSW); Heathcote-Graytown National Park, 20.xi.2005, *M.G. Corrick 11610* (CANB, MEL, NSW).

Distribution and habitat: Known only from the Dargile Forest, some of which is now incorporated into the Heathcote-Graytown National Park. Grows in box-ironbark forest on clay-loam soils derived from Devonian sediments. Associated species include *Eucalyptus microcarpa* (Maiden) Maiden, *E. tricarpa* (L.A.S.Johnson) L.A.S.Johnson, *Acacia pycnantha* Benth., *A. acinacea* Lindl., *Cassinia arcuata* R.Br., *Hibbertia exutiaces* N.A.Wakef., *Brachyloma daphnoides* (Sm.) Benth., *Arthropodium strictum* R.Br., *Dianella admixta* Gand.

Figure 2. Habit photograph of *Pultenaea dargilensis*.

Conservation status: The new species is currently known only from the one population which occupies c. 50 ha. The population is included within a national park. A conservation code of CR (Critically Endangered sensu IUCN 2001) is considered appropriate on the basis of the small, solitary population, but we have no evidence of population decline to date. On the basis of Beckler's early collections from the Pyalong district, it is possible that further populations await (re)discovery, however it is likely that other populations have been lost due to land clearance.

Phenology: Plants have been collected in flower in October and November, and in fruit in late November.

Notes: The new species is readily distinguished from *P. pedunculata* by its semi-erect to procumbent habit and its conspicuous, spreading or somewhat retrorse indumentum of stems, pedicels, calyces and at least young leaves. The latter is a species encompassing significant variation in leaf size and shape and indumentum density, but most of this variation is continuous across the geographic range of the species from Port Lincoln in South Australia, to near Newcastle in New South Wales and through eastern Tasmania.

Typical *P. pedunculata* is known from localities within at least 20 km of the site where *P. dargilensis* grows and is locally abundant at e.g. Pyalong and Redesdale, but the two are not sympatric.

Etymology: The epithet refers to the Dargile Forest near Heathcote in central Victoria, currently the only known locality for the species.

The following couplets modify the key to *Pultenaea* in the *Flora of Victoria* (Corrick 1996) to allow identification of *P. dargilensis* against *P. pedunculata*.

2	Flowers 1 per leaf axil (rarely 2) on distinct pedicels, usually much longer than leaves; shrubs mat-forming to decumbent	**2a**
2:	Flowers terminal, forming a condensed raceme or head-like cluster (occasionally solitary), sessile or shortly pedicellate; shrubs not mat-forming, mostly ± erect	**3**
2a	Shrubs mat-forming, variously hairy with antrorse to appressed hairs	**1. *P. pedunculata***
2a:	Shrubs not mat-forming, loosely procumbent or decumbent; stem hairs spreading to somewhat retrorse in 2 classes c. 0.1 mm and 0.5 mm long	***P. dargilensis***

Acknowledgements

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A taxonomic revision of *Acacia verniciflua* and *A. leprosa* (Leguminosae: Mimosoideae) in Australia

a253194

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Introduction

Acacia verniciflua (Varnish Wattle) and *A. leprosa* (Cinnamon Wattle) occur in temperate areas of eastern and southern Australia and as hitherto defined were regarded as highly polymorphic species in need of critical revision (Maslin 2001). The conventional separation between the species was the number of longitudinal nerves on their phyllodes, one in *A. leprosa* and two in *A. verniciflua*, but as correctly noted by Court (1972, p. 219), the importance of this character has been over-emphasised. During the nineteenth century a number of taxa were described that were referable to the *A. verniciflua* – *A. leprosa* group, however, none of these names was ever taken up, presumably because of difficulties in defining the taxa and uncertainties concerning the application of the names (some of which were based on plants cultivated in Europe for horticultural purposes). Court (1972, pp. 218–219, 234) was the first contemporary author to (briefly) discuss the complex variation within the two species. In that work he recognised the "highly polymorphic" nature of the variation within *A. verniciflua* while under *A. leprosa* he recognised an informal variant from the Dandenong Range (which we describe below as *A. stictophylla* Court ex Maslin & D.J.Murphy). An interesting specimen sheet of historical interest at the National Herbarium of Victoria (MEL 1528789) shows that as early as 1959 Court had recognised a number of the other taxa that we now accept for this group (Fig. 1).

A comprehensive taxonomic reassessment of *A. verniciflua* and *A. leprosa* was undertaken by the first author in connection with preparing the *Flora of Australia* treatment of *Acacia*. The results of that study were first published in the *Flora of Victoria* (Entwisle *et al.* 1996) and subsequently in the *Flora of Australia* (Maslin 2001). In these works, four informal variants were recognised within both *A. verniciflua* and *A. leprosa*, some corresponding to previously described taxa; it is that classification which forms the basic framework for the present paper.

Abstract

A revision of a taxonomically complex group of species allied to, and including, *Acacia leprosa* Sieber ex DC. and *A. verniciflua* A.Cunn. is presented. These species predominate in temperate regions of eastern Australia. Two new species are described, *A. rostriformis* Maslin & D.J.Murphy and *A. stictophylla* Court ex Maslin & D.J.Murphy and one, *A. exudans* Lindl., is resurrected. *Acacia leprosa* is treated as a highly polymorphic species comprising five varieties, four of which are described as new, namely, *A. leprosa* var. *uninervia* Maslin & D.J.Murphy, *A. leprosa* var. *graveolens* Maslin & D.J.Murphy, *A. leprosa* var. *magna* Maslin & D.J.Murphy and *A. leprosa* var. *crassipoda* Maslin & D.J.Murphy. *Acacia verniciflua* is similarly variable but no formal infraspecific taxa are recognised within it. Details of phyllode anatomy and resin glands are characterised by light and electron microscopy.

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These informal variants are given in Table 1, which also shows their corresponding currently accepted name. The five species (one containing five varieties) that are now recognised (column 1 in Table 1) comprise what is referred to here as the *A. verniciflua* – *A. leprosa* group.

In the absence of a meaningful phylogenetically based classification of the Australian acacias it is not possible to adequately contextualise species of the

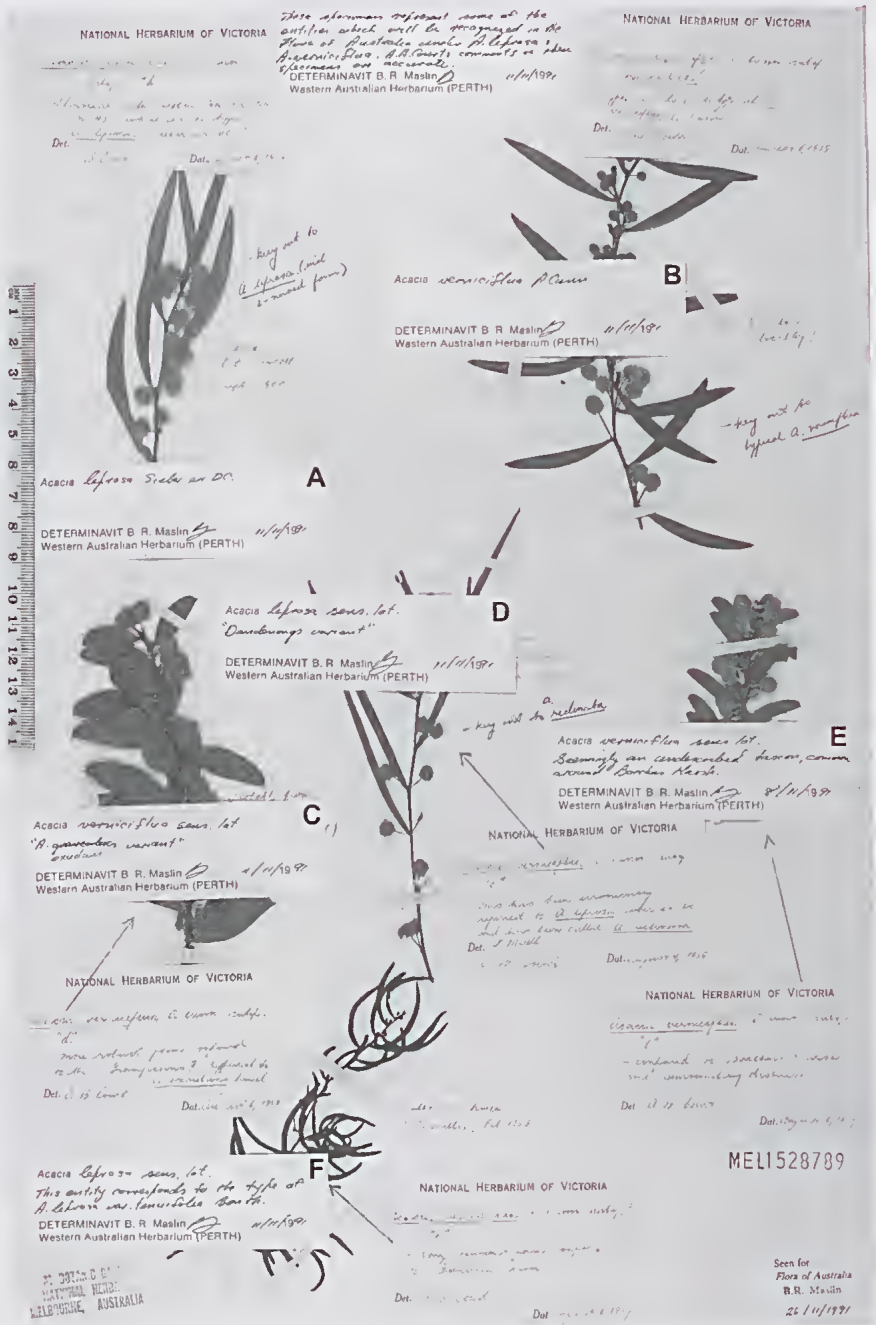

Figure 1. A historically interesting sheet prepared in 1959 by A.B. Court (MEL 1528789), showing taxa within the *A. verniciflua* – *A. leprasa* group that were recognised at that time. A – *A. leprosa* var. *uninervia* (Narrow phyllade variant); B – *A. verniciflua*; C – *A. exudans*; D – *A. stictophylla*; E – *A. rastrifarmis*; F – *A. verniciflua* (1-nerved variant).

A. verniciflua – *A. leprosa* group, however, these species belong to an assemblage of taxa that includes *A. ausfeldii* Regel (New South Wales and Victoria), *A. cognata* Domin (New South Wales and Victoria), *A. howittii* F.Muell. (Victoria) and *A. subporosa* F.Muell. (New South Wales and Victoria) as close relatives. These species are all characterised by their phyllodes being puncticulate (see below); additionally, these species are resinous and they have simple or reduced-racemose inflorescences with the peduncles subtended by a single, often rather prominent (sometimes caducous), navicular, cucculate and often rostriform basal bract. The South Australian species *A. dodonaeifolia* (Pers.) Balb. and *A. rhetinocarpa* J.M.Black probably also belong to this group but their phyllode punctae are very obscure. In south-eastern Australia *A. montana* Benth. (Queensland, New South Wales, Victoria and South Australia), *A. paradoxa* DC. (Queensland, New South Wales, Australian Capital Territory, Victoria, Tasmania and South Australia) and *A. stricta* (Andrews) Willd. (Queensland, New South Wales, Victoria, Tasmania and South Australia) are taxonomically not far removed from the above group, but their phyllodes are not puncticulate.

Species of the *A. verniciflua* – *A. leprosa* group occur in eastern and southern Australia where they show a discontinuous distribution, often on landforms associated with the Great Dividing Range. They extend from southern Queensland through New South Wales to the Grampian Range in western Victoria; there are also disjunct occurrences in South Australia (in the southern Lofty Range) and in Tasmania. The group has proliferated in Victoria with all taxa, except *A. leprosa* var. *leprosa*, recorded for that State (Table 1).

Methods

Morphology. This taxonomic treatment was based on a morphological examination of field-collected populations (principally from Victoria) and herbarium specimens obtained from all Australian herbaria having significant collections of material belonging to the *Acacia verniciflua* – *A. leprosa* group (including types). This included specimens from the following herbaria: MEL, PERTH, AD, CANB, NSW and HO. Additionally, relevant types from foreign herbaria were examined by BRM. These data were used to assess the status of taxa within the *A. verniciflua* – *A. leprosa* group and to prepare the descriptions that are presented below.

All specimens held by Australian herbaria that

Table 1. Taxa comprising the *A. verniciflua* – *A. leprosa* group preceded by the number under which each is treated in the text below and (in brackets) the number of longitudinal nerves on their phyllodes [column 1], the informal names that had previously been applied to them by Entwisle *et al.* (1996) and Maslin (2001) [columns 2 & 3], their Australian State of occurrence [column 4] and the number of head cells in the phyllode resin-glands (see text below for explanation[column 5]). The taxa are arranged in this table based on similarity and their presumed taxonomic relationships. [a] Murphy (1996); [b] Gardner *et al.* (2005); [c] Collins (1920). *Abbreviations for Australian States*: Australian Capital Territory (ACT), New South Wales (NSW), Queensland (Qld), South Australia (SA), Tasmania (Tas.) and Victoria (Vic.).

Name used in present work [no. longitudinal phyllode nerves]	Name used in Entwisle *et al.* (1996)	Name used in Maslin (2001)	Distribution	Resin-gland head cell no.
4. *A. stictophylla* [1]	*A. leprosa* (Dandenong Range variant)	*A. leprosa* (second variant)	Vic.	8[a]
2a. *A. leprosa* var. *leprosa* [1]	*A. leprosa* (type variant), *pro parte*	*A. leprosa* (first variant)	Qld, NSW	?
2b. *A. leprosa* var. *uninervia* [1]	*A. leprosa* (large phyllode variant)	*A. leprosa* (fourth variant)	NSW, Vic.	4[a], 4–8[b]
2c. *A. leprosa* var. *groveolens* [2]	*A. vernicifluo* (southern variant)	*A. vernicifluo* (second variant)	Qld, NSW, Vic., Tas.	5–8[b]
2d. *A. leprosa* var. *magno* [2]	Not recognised	Not recognised	Vic.	?
2e. *A. leprosa* var. *crossipodo* [2]	Not recognised	Not recognised	Vic.	4[a], 4–5[b]
3. *A. rostriformis* [2]	*A. verniciflua* (Bacchus Marsh variant)	*A. verniciflua* (fourth variant)	Vic.	8[a]
5. *A. vernicifluo* [(1) 2]	*A. vernicifluo* (common variant) *A. leprosa* (Seymour variant)	*A. vernicifluo* (first variant) *A. leprosa* (third variant)	S.A., Qld, NSW, ACT, Vic.	7–18[a,b,c], 12[a]
1. *A. exudons* [2]	*A. verniciflua* (Casterton variant)	*A. verniciflua* (third variant)	Vic.	20–32[a]

were examined for this study have been determined and annotated, and the distribution maps that are presented below are based on these specimens.

Notable morphological features that occur in species of the *A. verniciflua* – *A. leprosa* group warrant some explanation.

Branchlet ribs. The type of branchlet ribbing that occurs in *A. verniciflua* and *A. exudans* is very unusual and is rare in *Acacia*. In these two species the branchlet ribs are over-topped by a broad, flat, glabrous, yellow or green band of tissue; sometimes the impression of the underlying rib is seen along the centre-line of the bands (Fig. 2A & B). These bands are best observed on the penultimate branchlets; they dissipate with age to reveal the fine, narrow branchlet ribs. The narrow space between the bands is commonly filled with a thick layer of resin that sometimes protrudes above the band, especially in *A. exudans*. These bands are also present in *A. rostriformis* but in this species the branchlet rib (which is appressed-hairy) clearly protrudes above the band so that the yellow tissue is seen as flanking these raised ribs. With regard to its type of branchlet rib morphology *A. rostriformis* is intermediate between *A. exudans* and *A. verniciflua*, and those species which lack branchlet bands, namely, *A. leprosa* and *A. stictophylla*. In these latter two species the branchlets are simply marked with conventional ribs which are normally appressed-hairy (Fig. 2C & D). The ribs may be fine (*A. stictophylla*) or clearly raised as often occurs in *A. leprosa*. In *A. leprosa* the branchlets are often angled due to the prominence of the raised ribs.

Phyllode nerves. As already noted, the number of longitudinal nerves on the phyllodes has conventionally been used to distinguish *A. leprosa* (1-nerved) and *A. verniciflua* (2-nerved). While this is certainly a useful character for identifying taxa it must be used with some caution because it can occasionally vary within a taxon and because it is sometimes difficult to accurately determine the number of longitudinal nerves that are present on the phyllodes. As can be seen from Table 1, and photographed in Figure 3, one species is consistently one-nerved (*A. stictophylla*), two species are consistently 2-nerved (*A. exudans*, *A. rostriformis*) while the two highly polymorphic species, *A. leprosa* and *A. verniciflua*, contain both 1- and 2-nerved entities. In *A. leprosa* the phyllode nerve number is used to help define the five varieties that are recognised within that species; two of them (var. *leprosa* and var. *uninervia*) are 1-nerved while the remaining three (var. *crassipoda*, var. *magna* and var. *graveolens*) are 2-nerved. As discussed below under *A. leprosa* this infra-specific classification which places emphasis on phyllode nerve number is to some extent an artificial (although convenient) scheme. Within *A. verniciflua* we have been unable to resolve the complex patterns of variation, and the rare morphotype with 1-nerved phyllodes that occurs near Seymour in Victoria is not afforded formal rank. The remaining plants of this species have 2-nerved phyllodes, although sometimes the second nerve is poorly developed.

Often it is easy to determine the number of longitudinal nerves on the phyllodes by inspecting either herbarium of fresh material. In 2-nerved phyllodes, however, the adaxial nerve is sometimes less pronounced than the abaxial one and care must be taken not to misinterpret such phyllodes as being 1-nerved. This applies particularly to narrow phyllodes, especially in some plants of *A. verniciflua* from New South Wales. Occasionally the adaxial nerve is so reduced that it is scarcely visible, even under magnification, e.g. in a few New South Wales specimens of *A. leprosa* var. *leprosa*; these phyllodes are regarded as 1-nerved for the purpose of the key to taxa. Fine lateral nerves usually branch-off the main longitudinal nerve(s). These lateral nerves vary from few to numerous; *A. verniciflua* normally has fewer and/or more obscure of these lateral nerves than occur in most other taxa (compare Fig. 3A-B and 3C-D). The lateral nerves frequently anastomose and at their distal end they often coalesce to form a continuous, fine intra-marginal nerve on one or both sides of the phyllode; as can be seen in Figure 3B these intra-marginal nerves are crooked, not straight like the main longitudinal nerves. In most 2-nerved taxa some phyllodes can be found where the main longitudinal nerves are confluent or contiguous for a short distance above the pulvinus; we attach no taxonomic significance to this phenomenon. The nervation patterns discussed above can be seen on herbarium material but the best way (although not necessarily the most practical) of viewing them is to inspect fresh phyllodes with a ×10 magnification lens. With sunlight transmitted through the lamina the veins

can be readily seen, even the small lateral veins which may prove difficult to see from herbarium material or by using incident light in the field (Fig. 3).

In *Acacia* the number of longitudinal nerves that occur on the phyllodes is generally a conservative and stable character. However, as with all other characters in this complex genus, there are exceptions. For example, in the *A. bivenosa* DC. group (Chapman & Maslin 1992), an assemblage of largely Western Australian and arid zone taxa, we see the same range of variation for phyllode nerve number that occurs in the un-related *A. verniciflua* – *A. leprosa* group. In the *A. bivenosa* group there are species with consistently 1-nerved phyllodes (e.g. *A. ampliceps* Maslin), consistently 2-nerved phyllodes (e.g. *A. didyma* A.R.Chapm. & Maslin); while *A. bivenosa* itself contains both 1- and 2-nerved morphotypes. Additionally, *A. rostellifera* Benth. normally has 1-nerved phyllodes but sometimes develops an incipient second longitudinal nerve similar to that which occasionally occurs in *A. leprosa* var. *leprosa*.

Scanning electron microscopy analysis of phyllodes and resin-glands. Phyllode specimens from freshly collected plant material were preserved in 70% alcohol. This material showed little evidence of the resinous coating found on dried material and agitation in 100% ethanol proved to be effective at removing most of any remaining resin. Samples were critical point dried in a Tousimis Samdri pvt.3 critical point drier, mounted on stubs using Leit adhesive carbon tabs, and coated with gold for 3 minutes using an Edwards S150B sputter coater. Specimens were viewed using a JOEL JSM-840 Scanning Electron Microscope (SEM) with a probe current of 6 × 10-10 A and an accelerating voltage of 10 kV. The surfaces of a representative sample of phyllodes from 10 populations, comprising six of the nine taxa recognised in this study were examined using SEM.

The phyllodes of all members of the *A. verniciflua* – *A. leprosa* group are characterised by puncticulate phyllodes; the punctae may be few to numerous and comprise shallow, circular depressions that exude resin from microscopic *resin-glands* that are observable only at high microscopic magnification (greater then ×50). When the resin-glands exude resin this can fill the depressions on the phyllode surface in which they are located. Resin-glands may also be found on branchlets, pods and peduncles, where they are often less obvious because they do not occur in depressions. Resin-glands found on branchlets occur mostly in the interstices between ribs or bands. In fresh and dried specimens resin generally coats phyllodes (especially filling the punctae) and branchlets, but it may also cover other organs such as pods and peduncles. The resin is translucent but may darken upon drying (in herbarium specimens). Each resin-gland consists of a uniseriate stalk topped by a number of *head cells* (Collins 1920). To quantify head cell number requires scanning electron microscopy or compound light microscopy

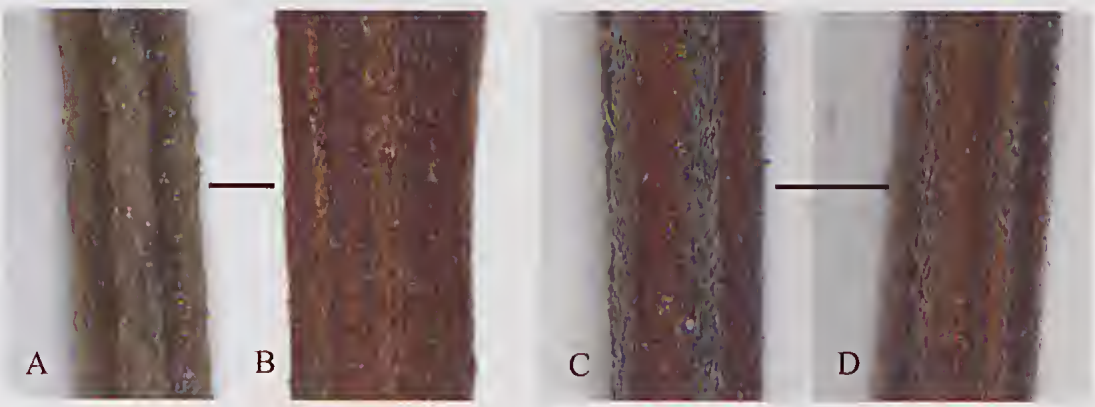

Figure 2. Branchlet rib characters. A & B: *Acocio vernicifluo*. Branchlets showing broad, glabrous, pale-coloured, low-profile bands (that obscure the underlying fine ribs) with the inter-rib space often filled with thick resin on penultimate branchlets (A) but no resin on mature branchlets (B). (Voucher specimen *B.R. Maslin* 5860). Scale bar = 1 mm. **C & D**: *Acacio leprosa*. Penultimate branchlets showing appressed-hairy, raised ribs (with a thin veneer of resin between the ribs). C – var. *leproso* (*A.S. Mitchell s.n.* NSW 167415); D – var. *uninervia* (*W.S. Wilson et ol.* 90). Scale bar = 1 mm.

using cleared phyllodes. The number and arrangement of head cells has taxonomic value in the *A. verniciflua* – *A. leprosa* group and was photographed and recorded in this study (Fig. 4, Table 1). It was observed that *A. exudans* and *A. verniciflua* usually had the largest resin-glands (c. 100 µm diameter (diam.)) with the highest number of cap cells (20–32 and 7–18 respectively). Some individuals of *A. leprosa* var. *uninervia* and *A. leprosa* var. *crassipoda* had the lowest number of cap cells (4–8 and 4 or 5 respectively), whereas *A. leprosa* var. *graveolens* had 5–8 cap cells. *Acacia rostriformis* and *A. stictophylla* both consistently had 8 cap cells per resin-gland. Because a limited sampling was undertaken the full range of variation in the resin-gland head cell number of the *A. leprosa* – *A. verniciflua* group remains to be quantified. However, we postulate that resin-gland head cell number provides some indication of relatedness of the taxa in this study, especially when combined with other characters, and therefore the taxa listed in Table 1 are ordered accordingly.

Boughton (1989), reviewing previous work, divided trichomes on *Acacia* phyllodes into five non-glandular and six glandular types. There is no published account for all the taxa included in the present study regarding the anatomical details of the resin-glands that secrete the resinous "varnish". Collins (1920) completed a detailed study using light microscopy of the development of the resin-glands in *A. verniciflua* collected from near Adelaide (although a voucher is not cited), while Gardner *et al.* (2005) characterised the resin-glands and head cell numbers using SEM from four of the taxa recognised herein. The resin-glands of the taxa in the *A. leprosa* – *A. verniciflua* group resemble the type illustrated in Dell (1977, Fig. 1D).

Boughton (1990) hypothesised that *Acacia* species maintain mechanical mechanisms to allow stomatal opening when phyllodes are coated with resinous material, and it was apparent (via SEM) that there were gaps in the resin coating above the stomata in *A. verniciflua* (Fig. 5). It is not known if resinosity is associated

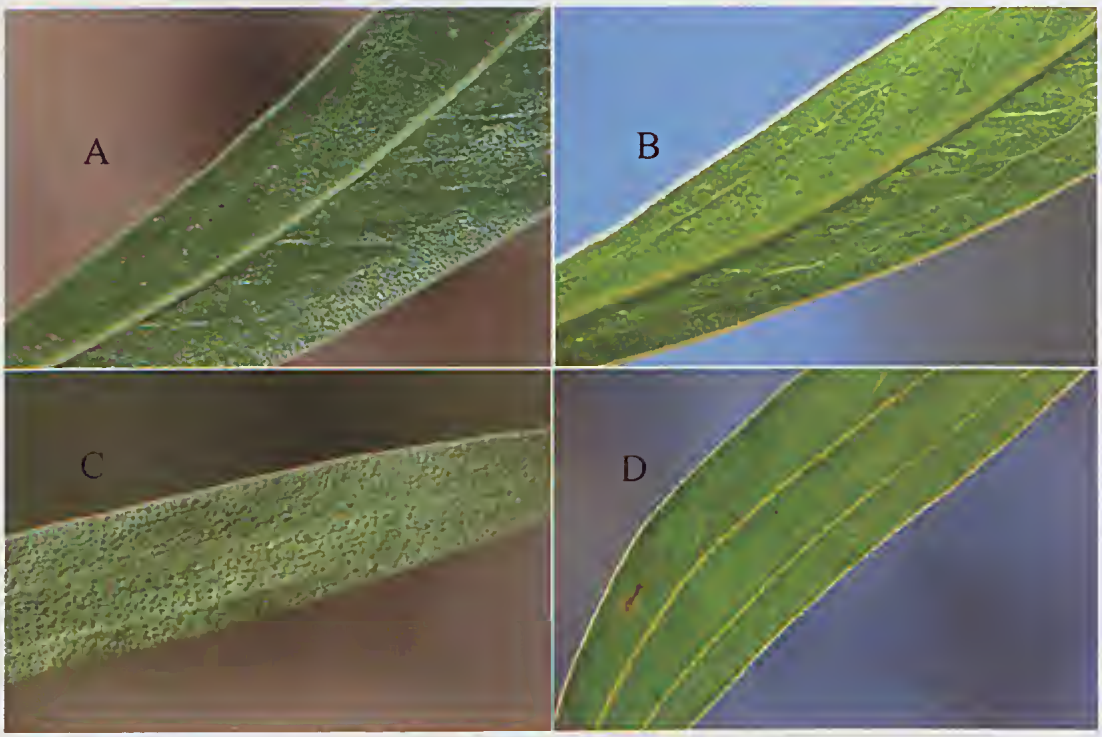

Figure 3. Phyllode nerves. A & B. *Acacia leprosa* var. *uninervia* (Large bracteole variant). Phyllodes with one longitudinal nerve that is more obvious with transmitted light (b) than with incident light (a). Note distal coalescence of fine lateral nerves to form continuous but uneven intra-marginal nerve on sides of the phyllode (most evident in B). (*B.R. Maslin* 9945). **C & D.** *Acacia verniciflua*. Phyllodes with two longitudinal nerves that are more obvious with transmitted light (d) than with incident light (c). Note punctae on surface of phyllode (A). (*B.R. Maslin* 9946).

with aromatic compounds in *Acacia*. While some taxa in the *A. verniciflua* – *A. leprosa* group are aromatic this does not clearly correlate with levels of resinosity.

Taxonomy

1. *Acacia exudans* Lindl., *in* T.L. Mitchell, *Three Exped. Australia* 2: 212 (1838)

Acacia verniciflua var. *latifolia* Benth., *Fl. austral.* 2: 358 (1864). *Type citation:* "Plains of the Glenelg, *Mitchell*." ***Type:*** interior of New Holland [just N of Casterton, Victoria], 1836 (sphalm. '25 March'), *T.L. Mitchell '34'*; *holotype*: CGE; *isotypes*: K (ex Herb. Cunningham, sphalm. '1835' and ex Herb. Bentham, sphalm. '1838'), MEL (dated 7 Aug. 1836), W (sphalm.'1839'). (See under *Typification* for discussion of these types.)

Acacia verniciflua (Casterton variant) sensu T.J. Entwisle *et al., Fl. Victoria* 3: 618 (1996).

Acacia verniciflua third variant sensu B.R. Maslin, *Fl. Australia* 11A: 597 (2001).

Acacia exsudans Benth., *orth. var.* [see A.D. Chapman, *Australian Plant Name Index, A–C*, p. 12 (1991) and B.R. Maslin, *Fl. Australia* 11A: 597 (2001)].

Illustrations. T.J. Entwisle *et al, Fl. Victoria* 3: 615, fig. 124j (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84F (2001).

Slightly aromatic, dense rounded *shrubs* 1–4 m tall, generally multi-stemmed from near base. *New shoots* slightly viscid, shiny. *Branchlets* not or only slightly

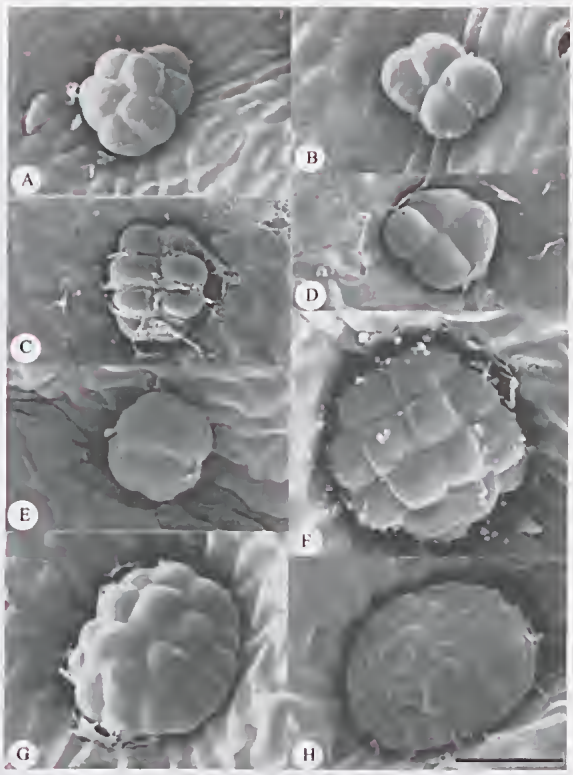

Figure 4. Scanning electron micrographs of phyllode resin-glands and head cell numbers. A. *A. stictophylla* (*D.J. Murphy* 14). **B.** *A. leprosa* var. *uninervia* (*D.J. Murphy* 103). **C.** *A. leprosa* var. *graveolens* (*D.J. Murphy* 125). **D.** *A. leprosa* var. *crassipoda* (*D.J. Murphy* 47). **E.** *A. rostriformis* (*D.J. Murphy* 25). **F.** *A. verniciflua* (*D.J. Murphy* 54). **G.** *A. verniciflua* (*D.J. Murphy* 156). **H.** *A. exudans* (*D.J. Murphy* 74). Scale bar = 50 µm.

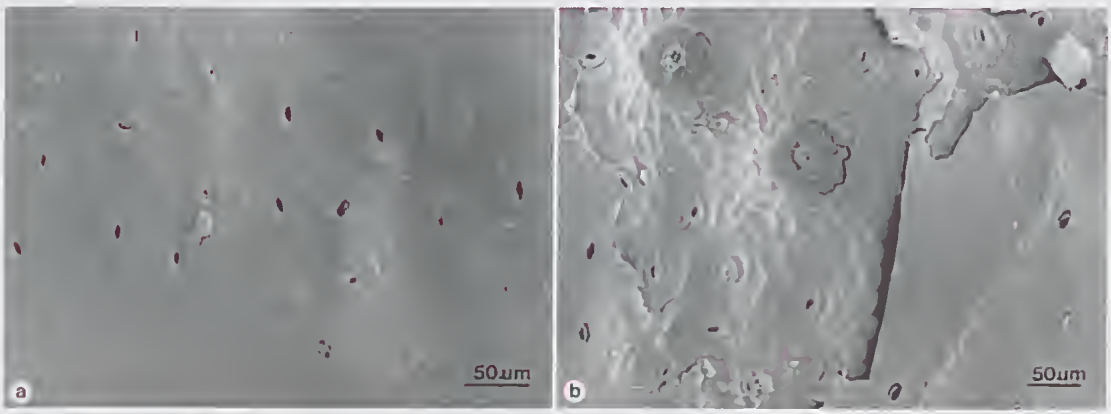

Figure 5. Scanning electron micrographs of phyllode surfaces. A. Phyllode surface of air dried *Acacia verniciflua* specimen without treatment to remove resin. Pores in the resin layer are visible above stomata. **B.** Phyllode surface from the same specimen with the resin partially removed. Note visible stomata and the depressions (punctae) in which damaged resin-glands are present. (*D.J. Murphy* 41).

Artificial key to taxa

1 Phyllodes with 2 longitudinal nerves on each face (the second nerve sometimes not well developed) 2

1: Phyllodes with 1 longitudinal nerve on each face (ignore any incipient second longitudinal nerve on upper side of main nerve; also ignore any uneven intra-marginal nerves formed by the distal confluence of lateral nerves) 7

2 Penultimate branchlets glabrous (except rarely sparsely appressed-hairy on some South Australian specimens), terete or slightly angled, marked with broad, flat (or slightly raised), pale-coloured bands often with thick resin in the narrow space between the bands 3

2: Penultimate branchlets appressed-hairy on raised ribs or if glabrous then lacking bands as above, often angled, not resinous or with a only a very thin veneer of resin between the ribs 4

3 Peduncles densely spreading-hairy, with persistent, large (3–4 mm long) basal bracts. Stipules normally persistent. Branchlets not flexuose. (Near Casterton, Victoria) ..... 1. *A. exudans*

3: Peduncles glabrous or appressed-hairy, basal bract normally caducous, small (0.5–2 mm long). Stipules caducous. Branchlets commonly flexuose. (Very variable species: South Australia, Queensland, New South Wales, Australian Capital Territory, Victoria) ..... 5. *A. verniciflua*

4 Phyllode apices obtuse and excentrically mucronate, rostriform to sub-uncinate; phyllodes mostly 20–45 mm long and 5–10 mm wide; peduncles very densely hairy; pods densely hairy at least when young. (Bacchus Marsh and Werribee, Victoria) ..... 3. *A. rostriformis*

4: Phyllode apices acute to acuminate or if obtuse the mucro centrally positioned; phyllodes often longer or wider than above; pods glabrous or sparsely appressed-hairy 5

5 Bract at base of peduncles persistent and large (3–4 mm long); bracteoles c. 2 mm long, with large acuminate laminae that are longer than the very short claws; peduncles 4–6 mm long, sub-glabrous to ±sparsely and minutely appressed or sub-appressed hairy (Otway Range, Victoria) ..... 2d. *A. leprosa* var. *magna*

5: Bract at base of peduncle early caducous or if persistent (rare) then smaller than above 6

6 Peduncles 2–4 (–5) mm long (often obscured by stamens at anthesis so that the heads superficially look sessile), very densely puberulous-tomentulose, c. 1 mm wide (including indumentum). Bracteoles often clearly acuminate with laminae longer than claws. Gland 0–1 mm above the pulvinus. (Grampians and Pyrenees Range, Victoria) ..... 2e. *A. leprosa* var. *crassipoda*

6: Characters not combined as above. (Very variable variety: Queensland, New South Wales, Victoria, Tasmania.) ..... 2c. *A. leprosa* var. *graveolens*

7 Branchlets glabrous, terete, marked with broad, flat or scarcely raised pale-coloured bands, often prominently flexuose. Phyllodes 1–5 mm wide, moderately to strongly incurved. (Near Seymour, Victoria) ..... 5. *A. verniciflua* (1-nerved variant)

7: Branchlets appressed-hairy on ribs or if glabrous then lacking pale-coloured, flat bands and often angled. Phyllodes often more than 5 mm wide, straight to shallowly incurved 8

8 Phyllodes some or all more than 7 mm wide, the lateral nerves quite evident but few to numerous. Gland normally 2–8 mm above pulvinus. (Vic. and N.S.W.) ..... 2b. *A. leprosa* var. *uninervia*

8: Phyllodes 2–7 mm wide, lateral nerves normally few and obscure or superficially absent. Gland 0–1.5 mm above pulvinus 9

9 Bracteoles spathulate, the laminae small (shorter than claws), acute or obtuse and not exserted in the buds; peduncles with a dense indumentum of uniformly very short, straight, closely appressed hairs; branchlet ribs often moderately to densely appressed-hairy (with hairs shorter than below). (Scattered distribution in New South Wales and Queensland) ..... 2a. *A. leprosa* var. *leprosa*

9: Bracteoles lanceolate, the laminae large (longer than claws), acuminate, exserted beyond flowers in young buds (but not in mature buds); peduncles with a looser, more open indumentum than above (the hairs quite long, curved and not closely appressed); branchlet ribs glabrous or very sparsely appressed-hairy (hairs to c. 0.5 mm long). (Dandenong Range, Victoria) ..... 4. *A. stictophylla*

flexuose, ±angled at extremities but soon terete, glabrous, marked with broad, flat or slightly raised bands of yellow tissue, the region between the bands narrow, dark-coloured and often filled with a thick coating of resin, the bands and/or resin obscure or absent with age. *Stipules* normally persistent (but brittle when dry and therefore sometimes absent from some nodes on herbarium material), brown (except green on new shoots), often recurved, (1–)2–4 mm long, 0.5–1 mm wide, acute. *Phyllodes* on raised stem projections which persist on older branchlets after phyllodes detach, narrowly oblong–elliptic to narrowly elliptic or oblanceolate, elliptic when phyllodes very broad, occasionally lanceolate, (25–)30–60 (–70) mm long, (5–) 6–17(–20) mm wide, straight or almost so, somewhat shiny, not obviously viscid (but see note below), dark green, normally glabrous (rarely appressed-puberulous on margins, especially young phyllodes), punctate with scattered, normally very obscure, shallow, circular depressions that often exude a glistening resin (the punctae large: observe at ×10 mag.); with 2 *longitudinal nerves* on each face, the nerves of equal prominence or the adaxial one slightly more prominent than the abaxial one; *lateral nerves* few and obscure; *apices* acute or obtuse, mucronate (mucro ±central); *pulvinus* 1–1.5 mm long, glabrous. *Gland* situated on upper margin of phyllode 0–3(–4) mm above the pulvinus, c. 1 mm long, sometimes not readily observable. *Inflorescences* simple, 1–2(–3) per axil; *peduncles* (4–)5–10 mm long, ±stout, densely tomentose with short, crisped, spreading hairs; *basal peduncular bract* early caducous or persistent to anthesis, cucullate-rostriform, sometimes cleft at apex, large (3–4 mm long, 2–3 mm wide), brown, glabrous; *heads* globose, large (6–9 mm diam. dry, not seen fresh), densely 50–60-flowered, presumably lemon yellow. *Bracteoles* exserted beyond flowers in young buds but not exserted when buds mature, spathulate, 1.5–2 mm long (equal to or exceeding calyx, but shorter than petals), the dark brown laminae quite large (about as long as the narrowly oblong or linear claws), acute to short-acuminate, densely pubescent abaxially and with an obvious (when dry) central nerve. *Flowers* 5-merous; *calyx* gamosepalous, shortly lobed. *Pods* often occurring in clusters of up to 5 per head, narrowly oblong, 20–70 mm long, 5–7(–8) mm wide, straight to curved, thinly coriaceous-crustaceous, glabrous, acute to short-acuminate, marginal nerve slightly thickened. *Seeds* longitudinal in the pods, obloid–orbicular, 3.8–4.3 mm long, 2.3–3.6 mm wide, shiny, dark brown to black; *funicle* normally twice-folded, sometimes once-folded; *aril* 1.4–2.4 mm long and 2.2–3.8 mm wide. Fig. 6.

Selected specimens examined: **VICTORIA:** Beside Glenelg Highway, c. 4 km E of Casterton, 3.xi.1982, *M.G. Corrick 8553* (MEL 658947); Lower Glenelg River, 1891, [*J.P.*] *Eckert 109* (MEL 1528984); Tahara, W of Hamilton, 15.vii.1991, *E.J. Fenton s.n.* (MEL 2012338); near Tahara, Murndal road, 28.ii.1996, *D.J. Murphy 65 & N. Middleton* (MEL 2312603, PERTH, CAN8); East Greenwald road 2.2 km from Princes Highway, 28.ii.1996, *D.J. Murphy 72 & N. Middleton* (MEL 2312604, PERTH); 8.7 km SW Digby, Dartmoor–Hamilton road, 28.ii.1996, *D.J. Murphy 78 & N. Middleton* (MEL 2312602, PERTH); Wando Vale, without date, *V. Robertson s.n.* (NSW 167413); about 5 km E of Casterton–Dartmoor main road, along Moonlight road (about 22 km SSW of Casterton), 1.x.1981, *P.S. Short 1316* (BRI, MEL 592248); Winnap, 24.ix.1967, *I.8. Wilson 774* (CAN8).

Distribution and habitat: Endemic in south-western Victoria where it occurs in the Wannon Natural Region in a small area bounded approximately by the towns of Casterton, Hamilton and Dartmoor. The Glenelg River and the Wannon River form the approximate western and northern limits of distribution respectively. *Acacia exudans* grows in low undulating country in heath or low eucalypt woodland. However, the region in which it grows has been extensively cleared for agriculture and most remaining plants are found along degraded road verges. Fig. 7A.

Conservation status: Based on the small number of populations and no known occurrences in conservation reserves, *A. exudans* is regarded as Endangered according to the criteria of the IUCN (EN b1a, biii *sensu* IUCN 2001). In addition, the occurrence of a hybrid between *A. exudans* and *A. howittii* (*N.G. Walsh 6771, C. Hurry & D.J. Murphy*, MEL) is cause for concern due to the risk of introgression and genetic pollution of the limited number of known individuals of *A. exudans*.

Flowering and fruiting period: Flowers in September and October. Pods with mature seeds have been collected from December to February and judging from extant material it is likely that seed would occur on plants until at least March.

Typification: The specimen regarded as the holotype of *A. exudans* is at herb. Cambridge (CGE) and is labeled "Interior of New Holland. *A. exudans m* [mihi]. Major Mitchells Expedition, 1836. 25 March (34)" [underlining

shows the information that is written in Lindley's hand]. Lindley described *A. exudans* in a footnote to Mitchell's journal entry for 10 August 1836 (Mitchell 1838), however, we have not been able to locate any specimen bearing this date. It is likely that the date given on the holotype is an error because on 25 March 1836 the Mitchell expedition was at the Lachlan River in New South Wales and there is no mention of *A. exudans* on that date in

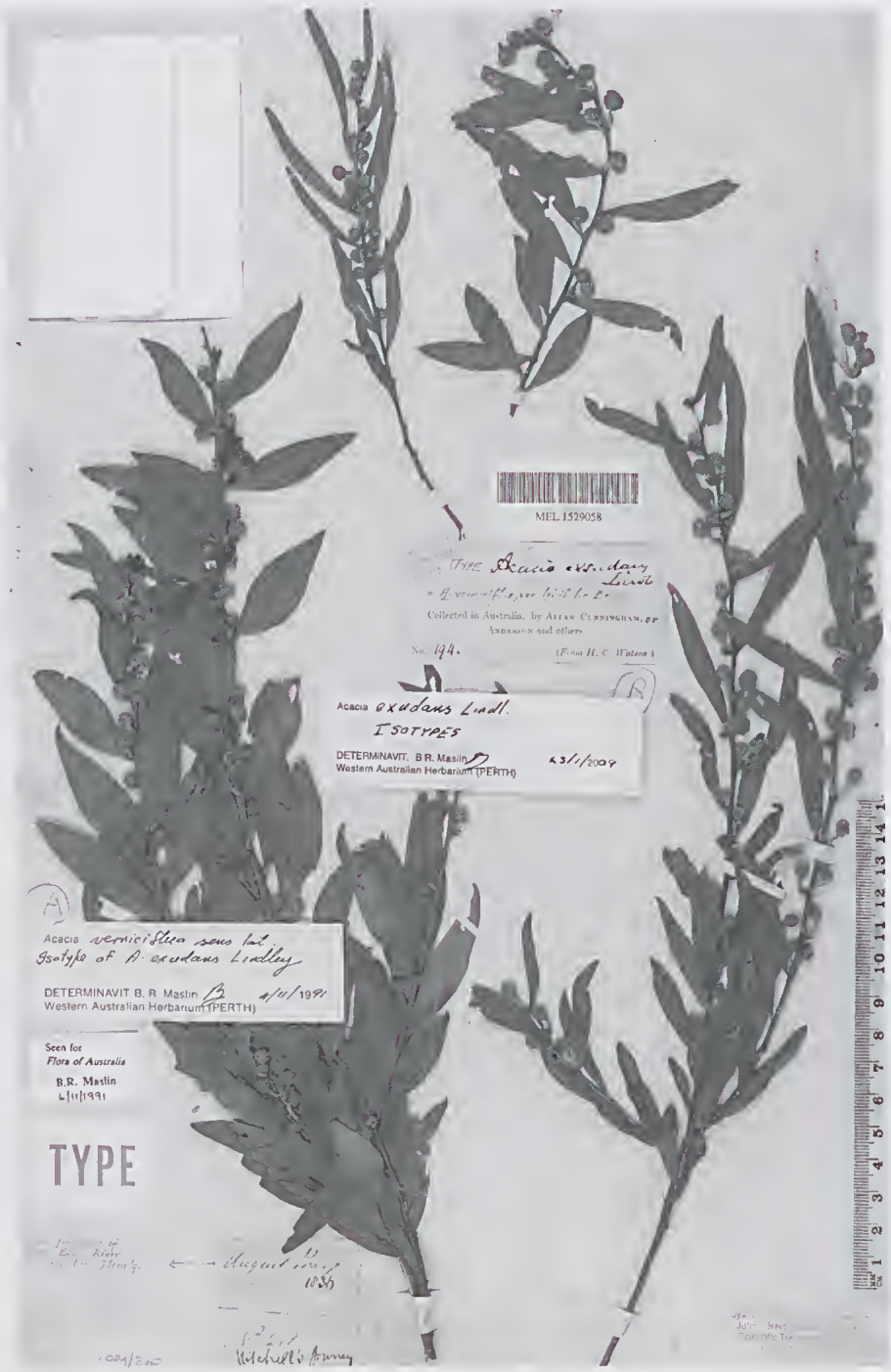

Figure 6. *Acacia exudans*. Isotype sheet at herb. MEL (see text for discussion).

Mitchell's journal nor is *A. exudans* known to occur in that area. On 10 August Mitchell was on the Glenelg River, about 6 km north of the town of Casterton in south-western Victoria (see Map 28 in Eccleston 1985). At the National Herbarium of Victoria (MEL) there is a Mitchell specimen of *A. exudans* which is regarded as an isotype (fig. 6), despite being dated 7 August 1836. On this day the Mitchell expedition was 18 km north of its 10 August locality, namely, at Stickfast Hill near the source of Steep Bank Rivulet (Map 27 in Eccleston 1985). Therefore, based on information currently available we are not able to say with certainty where exactly the type of *A. exudans* was collected. Perhaps Mitchell erred in ascribing his journal entry of the species to 10 August, perhaps the date on the MEL specimen (7 August) is an error for 10 August, or perhaps Mitchell collected the species on both 7 and 10 August 1836 and there is a specimen somewhere bearing the latter date. There are also Mitchell specimens of *A. exudans* at herb. Kew (K) and Vienna (W) that appear to be duplicates of the CGE holotype; these collections are also regarded as isotypes although they are erroneously dated 1835, 1838 or 1839.

Affinities: *Acacia exudans* is related to *A. rostriformis* on account of its 2-nerved phyllodes, densely tomentose peduncles and a somewhat similar banding on its branchlets. Both these species have very restricted geographic distributions and they are separated by a distance of about 300 km. *Acacia rostriformis* is most readily distinguished from *A. exudans* by its appressed-hairy branchlets which are not obviously resinous (glabrous and often thick-resinous in *A. exudans*), rostriform phyllodes with an excentric mucro (mucro central in *A. exudans*), caducous stipules (±persistent in *A. exudans*) and fewer-flowered heads (25–30 compared with 50–60). *Acacia exudans* may sometimes resemble *A. leprosa* var. *crassipoda* (see that variety for differences).

Acacia exudans is also related to *A. verniciflua*; these two species have the highest numbers of head cells in their resin-glands (see Table 1). However, *A. exudans* differs most obviously from *A. verniciflua* in having persistent stipules, large and often persistent basal peduncular bracts, and densely tomentose indumentum on its peduncles.

Note: In his account of the discovery of *A. exudans* Mitchell (1838, p. 214) describes the phyllodes as being 'covered with a clammy exudation resembling honey-

Figure 7A. Distribution maps for: **A.** *Acacia exudans*; **B.** *Acacia leprosa* var. *leprosa*.

dew'. However, no such exudate has been observed by us on herbarium specimens or from the second author's observations of living plants in the field. However, in greenhouse growth trials the plants commonly have a thin and viscid resinous coating, especially on younger phyllodes; presumably this is the type of exudate to which Mitchell was referring.

Hybridity: A hybrid between a cultivated plant of *A. howittii* and a naturally occurring plant of *A. exudans* was recently discovered near Casterton (*N.G. Walsh 6771, C. Hurry & D.J. Murphy*).

Common name: Casterton Wattle.

Etymology: The botanical name is derived from the Latin *exsudans* (exudate) and refers to the viscid phyllodes that were reported by Mitchell when he first discovered the species in August 1836 (but see under *Note* above).

2. *Acacia leprosa* Sieber ex DC., *Prodr.* 2: 450 (1825)

Type citation: "In Nova-Hollandia". ***Type***: Fl. Novae Holl. [New South Wales], *F.W. Sieber 455*; *holotype*: G-DC; *isotypes*: A, K, MEL, MO, NSW, NY, Z.

Slightly aromatic or non-aromatic *shrubs* 1–5 m tall, occasionally *trees* to 8–10 m, normally 1- or 2-stemmed with sparse (rarely bushy) crowns, the main branches erect or occasionally slightly pendulous. *Bark* grey and smooth. *New shoots* shiny and resinous, slightly viscid or not viscid. *Branchlets* straight or very slightly flexuose, not pendulous, rarely pruinose (var. *magna*), somewhat angled at extremities but becoming sub-angular then terete with maturity, finely ribbed, the ribs raised (commonly obviously so), yellowish to light brown or dark red-brown and sparsely to moderately appressed-puberulous with very short hairs, rarely glabrous, the inter-rib region wider than the ribs with ±same colour or darker-coloured and either non-resinous or with a very thin veneer of resin. *Stipules* caducous. *Phyllodes* elliptic or narrowly elliptic to lanceolate, rarely oblong-elliptic, oblanceolate-elliptic or ±linear, normally 50–140 mm long and 7–30 mm wide (occasionally 30–40 mm long and 3–4 mm wide in var. *graveolens* in Tasmania), straight to shallowly incurved, dull or (at least when fresh) slightly shiny, not obviously viscid, very thinly coriaceous, light green to dark green, sparsely and minutely appressed-puberulous on margins and nerves or sometimes glabrous, puncticulate with normally numerous and evident or obscure (at ×10 mag.), shallow, circular depressions that often exude a glistening resin (the punctae often darker-coloured than the surrounding lamina: observe at ×10 mag.); with 1 or 2 *longitudinal nerves* on each face, the nerves quite evident (raised when dry), when 2-nerved the nerves are of equal prominence or the adaxial one more pronounced than the abaxial one and they are sometimes contiguous or confluent for a short distance (to 10 mm) above the pulvinus; *lateral nerves* fine, commonly apparent (×10 mag.) when dry, occasionally (especially in var. *leprosa*) superficially absent, openly anastomosing, few to numerous, normally distally coalescing to form a fine, continuous but uneven intra-marginal nerve on one or both sides of the phyllode; normally gradually narrowed at *apices* to an acute or acuminate (rarely obtuse-mucronulate with central mucro), straight or rarely shallowly recurved tip, rarely abruptly narrowed and obtuse-mucronate (with a central mucro); *pulvinus* 1–2 mm long, appressed-puberulous or glabrous. *Gland* situated on upper margin of phyllode 0–8 mm above pulvinus, circular to clearly elongated. *Inflorescences* normally simple intermixed with rudimentary racemes, the racemes 1–2(–4) mm long, 1–3-headed and sometimes terminated by a vegetative bud; *peduncles* 2–6(–7) per axil, (2–)4–8(–11) mm long, sub-glabrous to densely puberulous, the hairs straight to sub-crisped and appressed to sub-appressed or occasionally wide-spreading; *basal peduncular bract* early caducous or occasionally (var. *magna*) persistent to anthesis, navicular-rostrate, acuminate or sometimes apically cleft, normally 1–2 mm long but 3–4 mm in var. *magna*, dark brown, glabrous; *heads* globular to slightly obloid, 10–15 mm diam. when fresh, (4–)6–10 mm when dry, (20–)28–40(–45)-flowered, pale yellow to lemon yellow. *Bracteoles* commonly obscure and over-topped by flowers in mature buds, occasionally exserted beyond flower buds, spathulate or lanceolate, 0.7–2 mm long (equal to or exceeding length of calyx), claws narrowly oblong, the dark brown laminae shorter to longer than the claws, puberulous abaxially and acute to acuminate (rarely obtuse). *Flowers* 5-merous; *calyx* gamosepalous, shortly lobed, 1/2–2/3 length of corolla, ±sparsely puberulous; *petals* glabrous or very sparsely hairy at apex. *Pods* (not seen for var. *magna*) linear to narrowly oblong, 30–90 mm long, 4–6 mm wide, raised over seeds along mid-line, straight to shallowly curved, chartaceous to thinly coriaceous, glabrous (rarely sparsely pilose)

or with sparse appressed hairs on margins (especially when young), sometimes transversely reticulate with nerves most evident at either edge of pods, marginal nerve indistinct. *Seeds* longitudinal in the pods, obloid to obloid-ellipsoid, 4–5 mm long, 1.5–2 mm wide, shiny, dark brown to black; *funicle* normally expanded into a once-folded terminal aril.

Distribution: Discontinuous along the Great Dividing Range from southern Queensland through New South Wales to the Grampian Range in western Victoria; also in Tasmania.

Taxonomy: *Acacia leprosa* is a highly variable species and five allopatric varieties are recognised to accommodate the variation (which is most pronounced in Victoria). As can be seen from Table 1 and from the synonymy presented below these varieties were treated as variants of either *A. leprosa* or *A. verniciflua* in Entwisle et *al.* (1996, pp 617–620) and Maslin (2001, pp 596–601). Most of the numerous specimens we examined can be accommodated by the five varieties but there are a few that cannot be satisfactorily placed and these are noted as variants under the variety that they most closely resemble.

The principal characters that have been used to define varieties within *A. leprosa* are phyllode width and the number of longitudinal nerves on the phyllodes, i.e. one or two (these two characters vary independently of one another), the types of peduncle indumentum, the persistence or otherwise of the basal peduncular bracts, and the shape and size of the bracteoles. Although bracteole morphology is a cryptic character that is hard to accurately assess without the use of a microscope it is an important and very useful character for recognising morphotypes.

Most of the variation within *A. leprosa* is found in Victoria where all the taxa, except var. *leprosa*, occur. The conventional definition of *A. leprosa* was that of a species comprising plants with 1-nerved phyllodes, however, we now expand this definition to also include plants with 2-nerved phyllodes. Phyllode nerve number is consistent within each variety but this may, to some extent at least, be a function of how we have defined the varieties! Phyllode nerve number is an easy character to see and to characterise, but as with any morphological attribute, nerve numbers may possibly be the result of convergence or reversals. Notwithstanding this we have used phyllode nerve number (one or two) to help define and key the varieties that are recognised here. While some of our taxa may well be redefined by future workers we believe that the classification that we propose is a reasonable attempt at providing meaningfully defined taxa to accommodate the very complex patterns of variation that exist within this species. The notes on variation and affinities provided under the varieties will assist future workers who wish to re-assess our classification, this applies particularly to var. *leprosa*, var. *graveolens* and var. *uninervia*.

Etymology: The species name is derived from the Latin *leprosus* (scaly) and refers to the punctae that mark the surface of the phyllodes of this species.

2a. *Acacia leprosa* var. *leprosa*

Acacia leprosa (type variant) sensu T.J. Entwisle et *al.*, *Fl. Victoria* 3: 619 (1996), pro parte (excluding elements referable to Victoria).

Acacia leprosa first variant sensu B.R. Maslin, *Fl. Australia* 11A: 598 (2001).

Illustrations. T. Tame, *Acacias SE Australia* 109, fig. 107a & b, pl. 107 (1992); T.J. Entwisle et *al.*, *Fl. Victoria* 3: 622, fig. 125a (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84I (2001).

Shrubs 1.5–4 m tall. *Phyllodes* (40–)50–90 mm long, 3–7 mm wide, the punctae quite evident (observe at ×10 mag.); with 1 *longitudinal nerve* (rarely an incipient second nerve in New South Wales plants); *lateral nerves* superficially absent or very few and obscure. *Gland* 0–1.5 mm above the pulvinus. *Peduncles* (2–)4–5 mm long when in flower, to 8 mm in fruit, densely puberulous with hairs short, ±straight and closely appressed; *basal peduncular bract* early caducous, c. 1.5 mm long. *Bracteoles* scarcely visible in mature buds being overtopped by flowers, spathulate, 0.7–1 mm long (±equal in length to calyx), the laminae small (less than length of the claws) and acute or occasionally short-acuminate. Fig. 8.

Selected specimens examined: **QUEENSLAND:** 8.2 km by road, NE of Doolool Tops homestead, via Monto, *A.R. Bean 928* (BRI *n.v.*, NSW *n.v.*, MEL, MEXU *n.v.*); Sydney Heads, 32 km NNW of Nebo, 10.xi.1990, *A.R. Bean 2552* (BRI). **NEW SOUTH WALES:** Hill Top, Jan. 1915, *E. Cheel s.n.* (NSW 451625); Fire Road 3, Chain of Ponds Crossing South, 9.x.1969, *A.S. Mitchell 556* (K, CANB, P *n.v.*, NSW, MEL); 1 mile [1.6 km] S of Chain of Ponds crossing, 9.x.1969, *A.[S.] Mitchell s.n.* (NSW 167415, PERTH 02941651).

Distribution and habitat: Widespread but not common in eastern Australia where it is known from a few scattered localities associated with the Great Dividing Range from southern Queensland and central New South Wales. In Queensland it occurs in the Denham Range, about 70 km SW of Mackay (Leichhardt district) and about 400 km to the SE in the vicinity of the Calliope Range (about 120 km NW of Bundaberg) in the Port Curtis district. In New South Wales it occurs in the Central Tablelands near Mittagong (Hill Top and Chain of Ponds Creek) and may possibly occur also at Mt Werong in the Blue Mountains, about 80 km due NW of Mittagong (see discussion under *A. leprosa* var. *graveolens* for details). In Entwisle *et al.* (1996, p. 619)

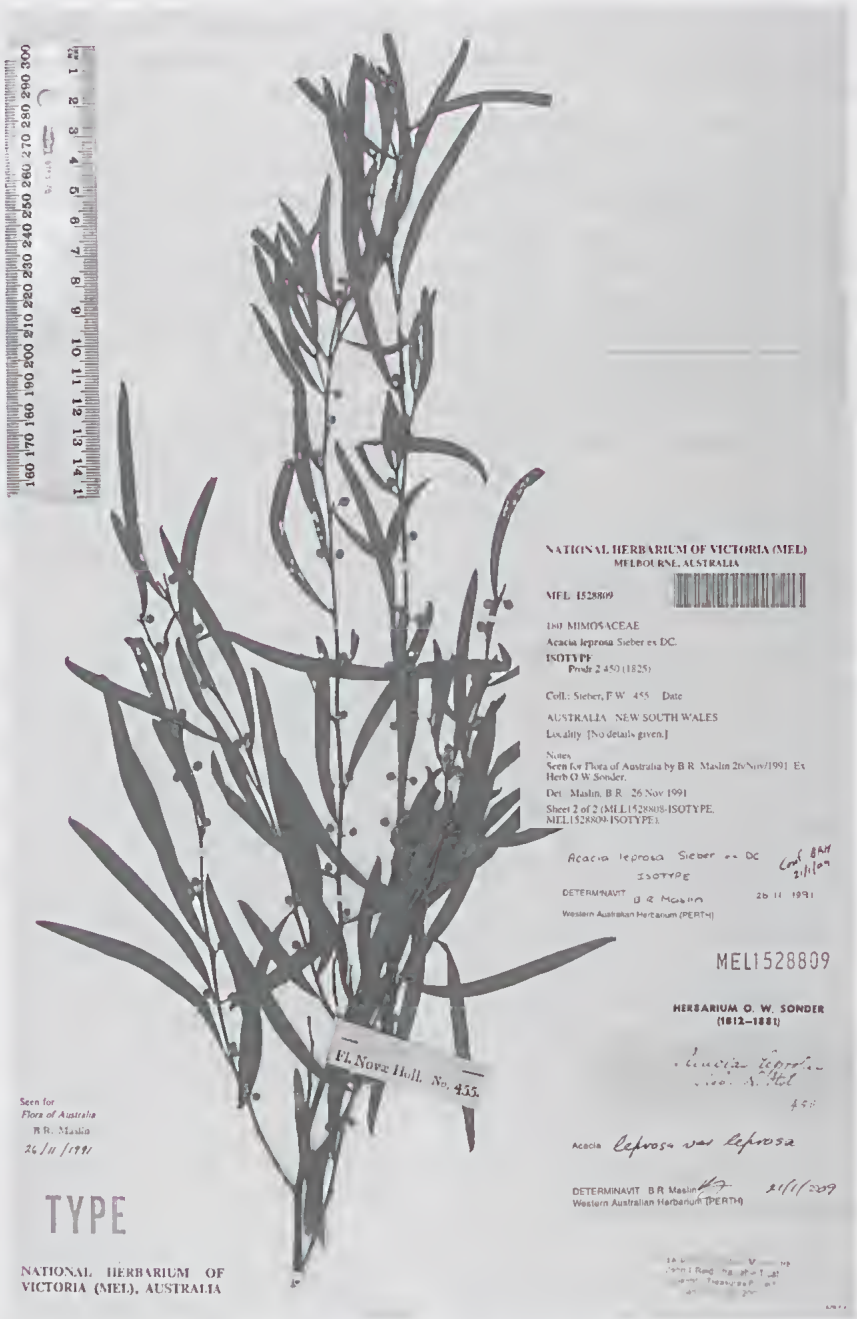

Figure 8. *Acacia leprosa* var. *leprosa*. Isotype (*F.W. Sieber* 455), herb. NSW specimen.

and Maslin (2001, p. 599) var. *leprosa* (as *A. leprosa*) was considered to occur in Victoria but the specimens upon which these records were based are now referred to *A. leprosa* var. *uninervia*. Variety *leprosa* grows in eucalypt woodland on ridge tops and steep slopes, in grey clay loam or shallow sand. Fig. 7B.

Taxonomy: As defined here var. *leprosa* is distinguished from the other varieties of *A. leprosa* by its narrow (not above 7 mm wide), 1-nerved phyllodes. While this is a convenient classification it may, to some extent at least, be artificial because this variety seems to grade into both *A. leprosa* var. *graveolens* (around Mt Werong in New South Wales) and *A. leproso* var. *uninervia* (in the high country to the north-east of Melbourne, Victoria) – see under these two varieties for further discussion. Some plants of *A. stictophylla* from the Dandenong Range, Victoria, superficially resemble those of var. *leprosa* but are distinguished most readily by their bracteole morphology and peduncle indumentum (see *A. stictophyllo* for discussion).

Conservation status: Due to the small number of collections and scattered distribution of this taxon, and limited information about population sizes, *A. leprosa* var. *leproso* is considered to be Near Threatened according to the criteria of the IUCN (NT *sensu* IUCN 2001).

Flowering and fruiting period: Flowers in September and October. Pods with mature seeds have been collected in late November to December.

Common name: Cinnamon Wattle.

2b. *Acacia leprosa* var. *uninervia* Maslin & D.J.Murphy, *var. nov.*

Frutices 2–5 m alti. *Ramuli* tenuiter costati, costis plerumque sparse vel modice appresse-puberulis. *Phyllodia* plerumque (40–)70–140 mm longa, (6–)8–15(–18) mm lata, puncticulate; *nervo longitudinali* 1 prominenti in quoque facies posito. *Glons* (0–)2–8 mm supra pulvinum. *Inflorescentiae* plerumque simplices immixtae cum racemis rudimentaribus; *pedunculi* 3–5(–7) mm longi, modice vel dense ±appresse puberuli; bractea basalis peduncularis mature caduca. *Bracteolae* 1(–2) mm longae, laminis longitudine unguis brevioribus vel ±aequantibus acutis vel breviter acuminatis. *Flores* 5-meri; calyx breviter lobatus. *Legumino* linearia vel anguste oblonga, 30–90 mm longa, 4–6 mm lata. *Semino* in leguminibus longitudinaliter ordinata, arillata.

Shrubs 2–5 m tall. *Branchlets* finely ribbed, the ribs normally sparsely to moderately appressed-puberulous. *Phyllodes* mostly (40–)70–140 mm long, (6–)8–15(–18) mm wide, puncticulate; with 1 prominent *longitudinal nerve* on each face. *Glond* (0–)2–8 mm above the pulvinus. *Inflorescences* normally simple intermixed with rudimentary racemes; *peduncles* 3–5 (–7) mm long, moderately to densely ±appressed-puberulous; *basal pedunculor bract* early caducous. *Bracteoles* 1(–2) mm long, the laminae shorter than or ±equal to length of claws and acute or short-acuminate. *Flowers* 5-merous; calyx shortly lobed. *Pods* linear to narrowly oblong, 30–90 mm long, 4–6 mm wide. *Seeds* longitudinal in pods, arillate.

***Type*:** 4 km NE of Healesville on the Maroondah Highway to Alexandra, Victoria, 12.ix.1985, *B.R. Maslin 5941*; *holotype*: PERTH 00822469; *isotypes*: CANB, K.

Acacia leproso (large phyllode variant) sensu T.J. Entwisle *et al., Fl. Victoria* 3: 620 (1996).

Acocia leprosa fourth voriont sensu B.R. Maslin, *Fl. Australio* 11A: 599 (2001).

Illustrations. T.J. Entwisle *et ol. Fl. Victorio* 3: 622, fig. 125d (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84J–L (2001).

Bushy or openly branched *shrubs* 2–5 m tall. *Phyllodes* mostly (40–)70–140 mm long, (6–)8–15(–18) mm wide; with 1 *longitudinol nerve*, the nerve prominent; *loterol nerves* few to numerous, often quite evident (at least when dry) and distally coalescing to form a fine, continuous but uneven intra-marginal nerve on one or both sides of the phyllode. *Glond* commonly 2–8 mm above the pulvinus but sometimes less (0–2 mm), often clearly elongated and 1–2 mm long (but ranging to circular or oblong-elliptic and 0.5 mm long). *Peduncles* 3–5(–7) mm long, moderately to very densely puberulous with straight, appressed or sub-appressed hairs; *basal peduncular bract* early caducous, c. 1.5 mm long. *Brocteoles* usually scarcely visible in mature buds being over-topped by the flowers (slightly exserted in the large bracteole and Nayook Creek variants), spathulate, usually c. 1 mm long and equal in length to calyx (c. 2 mm long and exceeding the calyx, but shorter than the corolla in the large bracteole variant), the laminae shorter than or ±equal to length of claws and acute or short-acuminate. Fig. 9.

Selected specimens exomined: **Typical variant. NEW SOUTH WALES:** Mt Tayar, 17 miles [27 km] SE of Rylestone, 24.ix.1964, *E.F. Constable 5059* (MEL, NSW, PERTH). **VICTORIA:** Woori Yallock, 18.iv.1904, *onanymous* (MEL 1500499); Kilmore Junction [near Seymour], 10.xi.1906, *anonymous* (MEL 1500501); Upper Yarra, *[J.] Dollochy [414]* (MEL 1528797, specimen seen by Bentham); Toolebewong to Healesville road, 1 mile [1.6 km] S of Le Chateau Private Hospital gateway, 1.ix.1965, *R. Filsan 7380* (MEL); Melbourne area, Riddells Creek, Gap Road, 28.v.1990, *J.C. Kissone 1567* (MEL, PERTH); Kinglake National Park, Full and Plenty track, 26.ix.1996, *K. Macforlane 173* (MEL); 2.5 km W of Melba Highway on Kinglake Road, c. 7 km E of Kinglake, 4.ix.2004, *B.R. Maslin 8583 & D.J. Murphy* (MEL, PERTH); Buffalo River, 18.ix.1928, *W. Mitchell s.n.* (MEL 674575);

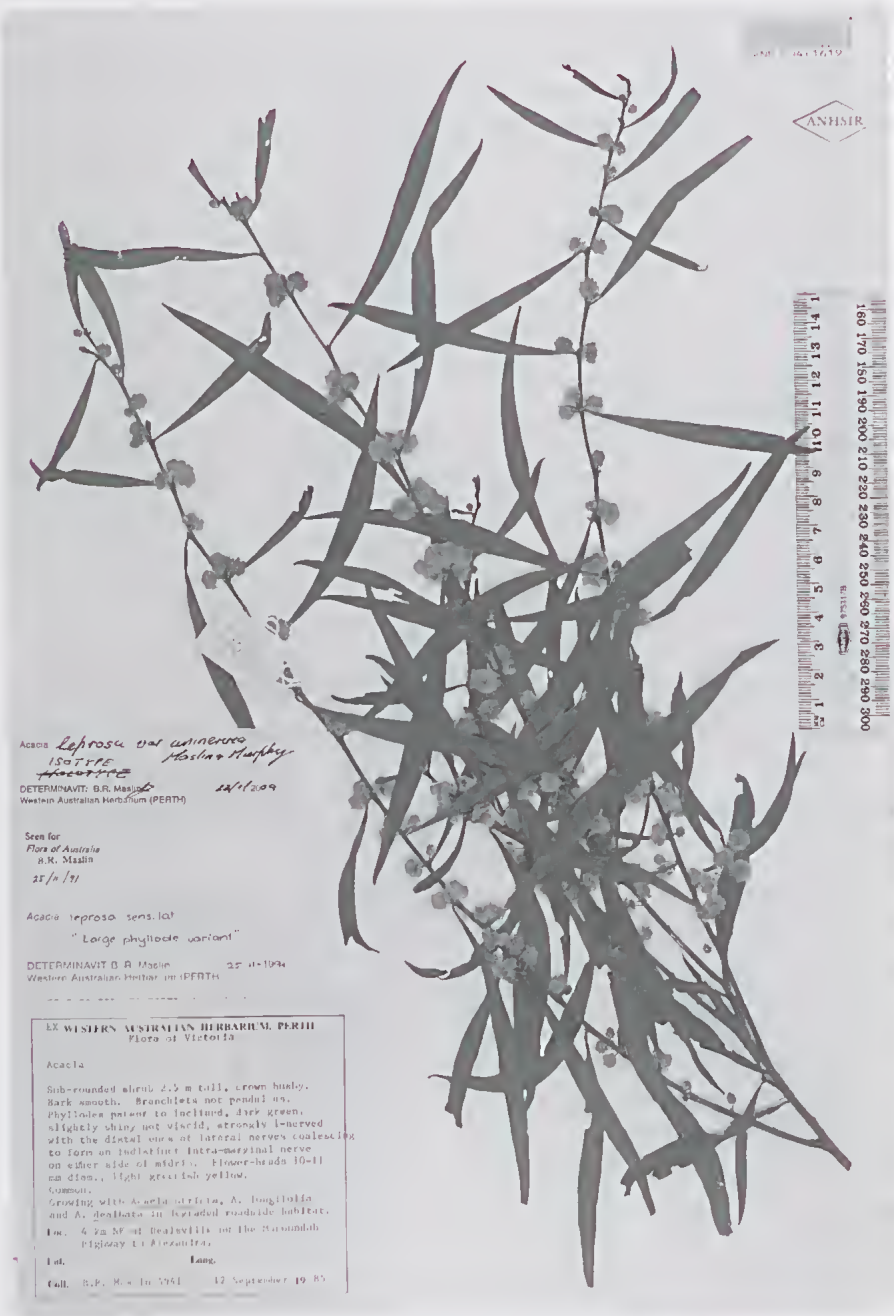
ANHSIR
Acacia leprosa var uninervia
ISOTYPE
Maslin & Murphy
DETERMINAVIT: B.R. Maslin
Western Australian Herbarium (PERTH)
Seen for
Flora of Australia
B.R. Maslin
Acacia leprosa sens. lat
"Large phyllode variant"
DETERMINAVIT B. R. Maslin
Western Australian Herbarium (PERTH)
EX WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Victoria
Acacia
Sub-rounded shrub 2.5 m tall, crown bushy.
Bark smooth. Branchlets not pendulous.
Phyllodes patent to inclined, dark green,
slightly shiny not viscid, strongly 1-nerved
with the distal ends of lateral nerves coalescing
to form an indistinct intra-marginal nerve
on either side of midrib. Flower-heads 10-11
mm diam., light greenish yellow.
Summit.
Growing with Acacia stricta, A. longifolia
and A. dealbata in forested roadside habitat.
Loc. 4 km SE of Healesville on the Maroondah
Highway at Fiveways.
Ht. Long.
Coll. B.R. Maslin 5941 12 September 19 85

Figure 9. *Acacio leprosa* var. *uninervio*. Isotype (*B.R. Moslin* 5941), herb. CANB specimen.

Black Range State Forest near Buxton, 19.ix.1979, *A. Morton 337* (MEL); 6 miles [9.6 km] N of Bullengarook and c. 2 miles [3.4 km] SE of Trentham, 3.ix.1961, *I.B. Muir 2179* (MEL); Orbost, Sep. 1900, *E. Pescott s.n.* (MEL 1500484); Yarrabula Creek Road, Hurdle Creek Pine Plantation, Carboor East, Sep. 1990, *M.H. Simmons 2332* & *J.G. Simmons* (NSW, PERTH); Womba State Forest, c. 3 km ESE from Spargo Creek on Cairns Road, 24.ix.2006, *V. Stajsic 44B6* & *J. Eichler* (MEL); Grampian Mts, Sep. 1B9B, *C. Wolter s.n.* (AD 973160S2, specimen ex MEL); Bacchus Marsh, 18B2, *W.H. Webster s.n.* (MEL 1520912); Myers Creek Road, Healesville, 15.ix.196S, *L.H. Willioms 557* (NSW). **Narrow phyllode variant. VICTORIA:** Upper Yarra Park [Healesville district], 37°44'S, 145°37'E, 21.xi.19B2, *A.C. Beouglehole 71619* & *C.M. Beordsell* (MEL); Mt Buffalo National Park, NE study area, 14.ix.19B7, *A.C. Beouglehole BB526* & *A.D.J. Piesse* (MEL); Boulder Creek, on Yarraboula Creek track, at base of Mount Buffalo Range, c. 30 km S of Myrtleford, 19.i.2009, *B.R. Maslin 9947* & *A. Gibb* (MEL, PERTH); Boulder Creek bank a few metres downstream from track and 10.4 km SSE of track junction with Lake Buffalo–Myrtleford road, 23.ix.19B7, *W.S. Wilson, A.D.J. Piesse* & *N.T. Rossiter* NTR *90* (MEL, PERTH); Mt Buffalo plateau, at Mollisons Gallery in far SW sector, 19.ii.1963, *J.H. Willis s.n.* (MEL 152B943); Mt Buffalo plateau, at Mollisons Gallery in far SW sector, 2B.i.2000, *N.G. Walsh 5151* (MEL). **Large bracteole variant. VICTORIA:** 14 km SW of Alexandra, 9.viii.19B2, *A.C. Beouglehole 706B3* (MEL); Toolangi State Forest, c. 5 km S of Murrindindi Casacades picnic area, on Wilhelmina Falls Road, 20.v.2007, *V. Stojsic 4445* & *N. Klozengo* (MEL); 6 km E of Marysville, 1B.i.2009, *B.R. Moslin 9945* (MEL, PERTH). **Nayook Creek variant. NEW SOUTH WALES:** Nayook Creek, about 1–2 km upstream of Deep Pass, 1B.ii.1990, *P.D. Hind 5972* & *C.K. Ingrom* (NSW, MO); upper Nayook Creek, upstream of Deep Pass, 21.i.1993, *P.D. Hind 65B4* & *W. Cherry* (MEL, NSW).

Distribution and habitat: Occurs in Victoria where it is most common in the ranges from the north to east of Melbourne, but with scattered occurrences west to the vicinity of Ballarat (e.g. *V. Stajsic 4486* & *J. Eichler*). There is a disjunct occurrence of the typical variant in New South Wales at Mt Tayar, about 30 km southeast of Rylestone; also, a variant with long bracteoles occurs on Nayook Creek in the Newnes State Forest, about 40 km to the south-east of Mt Tayar. Early Victorian records from Orbost (*E. Pescott s.n.*), near Seymour (*anonymous* MEL 1500501), Bacchus Marsh (*W.H. Webster s.n.*) and the Grampian Range (*C. Walter s.n.*) have not been confirmed with recent collections; these records may be errors, based on cultivated plants, or they may indicate that the variety no longer exists in these areas. *Acacia leprosa* var. *uninervia* is generally found in the understorey of damp *Eucalyptus* woodland or forest. Fig. 10A.

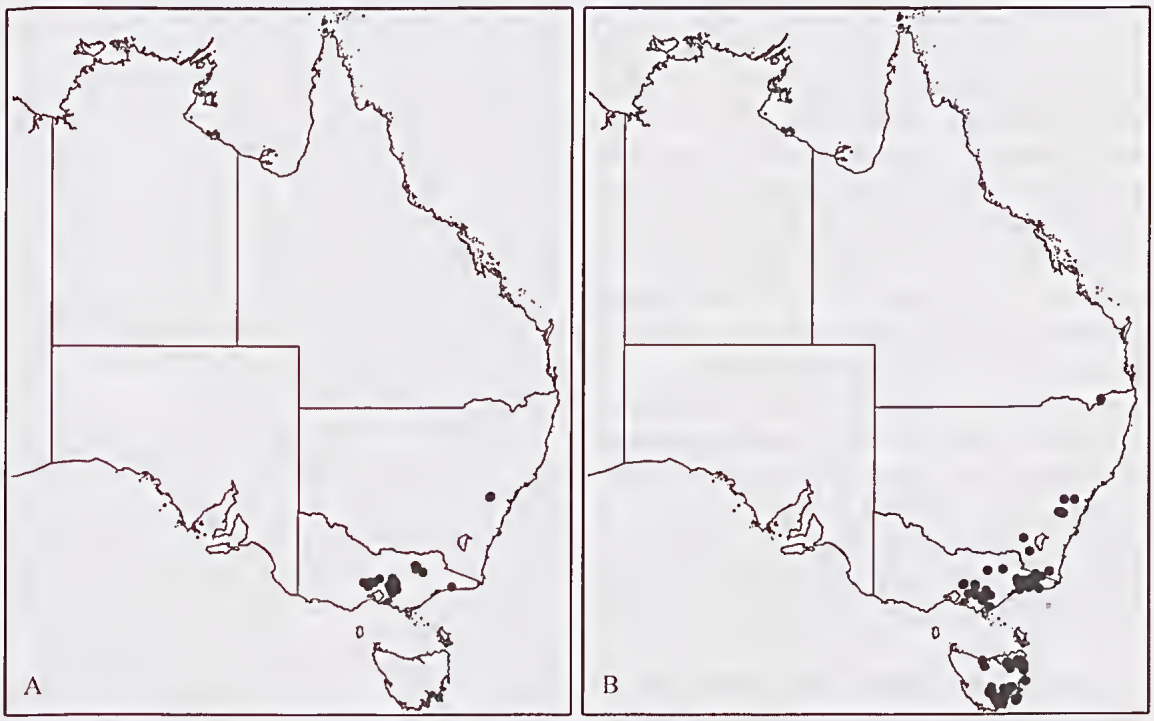

Figure 10. Distribution maps for: **A.** *Acocio leproso* var. *uninervio*; **B.** *A. leprosa* var. *graveolens*.

Conservation status: Based on the criteria of the IUCN *A. leprosa* var. *uninervia* is regarded as a taxon of Least Concern (LC *sensu* IUCN 2001).

Flowering and fruiting period: Flowers from late August to early October. Pods with mature seeds have been collected in January (fruiting is likely to extend to February).

Taxonomy: Further study is needed to verify the taxonomic status of *A. leprosa* var. *uninervia* as defined here. The variety is distinguished from the other varieties of *A. leprosa* by a combination of its broad phyllodes (mostly 8–15 mm wide) which are prominently 1-nerved and which normally have quite evident (when dry) lateral nerves that distally coalesce to form an uneven intra-marginal nerve on one or both sides of the midrib. Another character that is useful in recognising this variety is that the gland is often, but not always, 2–8 mm above the pulvinus. See further notes below under *Variation* and *Affinities* below.

Variation: Some Victorian plants from Yarra Park (in the Healesville district) and Mount Buffalo (150 km due NE of Healesville) have narrower than normal phyllodes [6–9(–12) mm wide] with the gland situated at the distal end of the pulvinus. Normally the phyllodes of var. *uninervia* are 8–15 mm wide and with the gland 2–8 mm above the pulvinus. The narrow phyllode variant of var. *uninervia* is represented by the few collections cited above and closely resembles plants of *A. leprosa* var. *leprosa* (which occurs in Queensland and New South Wales) but are provisionally excluded from that variety because at least some phyllodes exceed 7 mm wide and have (when dry) a more pronounced lateral nervation. This narrow phyllode variant of var. *uninervia* appears to be uncommon and although it is found in the general area where the typical variant (with wide phyllodes) occurs, the two are not known to be sympatric.

A variant of var. *uninervia* characterised by larger and more acuminate bracteoles than normal occurs in the high mountain region of Victoria around Marysville, Alexandra (about 25 km due N of Marysville) and Toolangi State Forest (about 30 km due E of Marysville). The bracteoles on these plants are about 2 mm long and are slightly exserted beyond the flowers in the mature buds. In the typical variant of var. *uninervia* (which occurs at Healesville, 25 km SE of Marysville and which is at a lower elevation) the bracteoles are about 1 mm long and acute to short-acuminate, they are scarcely evident in mature buds being over-topped by the flowers. Plants of the large bracteole variant also have patent-hairy peduncles (peduncle hairs appressed or patent in the normal variant) and 35–45 flowers per head (slightly more than the normal variant which has 25–35 flowers per head). Limited observations by the first author of the Marysville plants suggest that the large bracteole variant may commence flowering about a month later than the normal variant (the typical variant represented by *B.R. Maslin 5941*, the type, from Healesville that was at full anthesis in mid-September 1985 whereas the large bracteole variant from Marysville represented by *B.R. Maslin 5942* was with semi-mature flower buds at that same time). Future studies may show that formal recognition of this large bracteole variant is warranted. Finally, it is worth noting that a very unusual red-flowered form of this large bracteole variant was discovered in 1995 from near Wilhelmina Falls, Victoria, and subsequently named as the cultivar *Acacia leprosa* 'Scarlet Blaze' (Brueggemeier 2007; Plant Breeders Rights Australia 2001). The parent plant of *Acacia leprosa* 'Scarlet Blaze' is apparently extinct from the original collection locality, although progeny have been widely disseminated in horticulture (Cross 2001).

A variant, known from only the two collections cited above (one in young bud, the other in mature fruit), occurs at Nayook Creek, New South Wales, and it is described as a common shrub 1–3 m tall. It has distinctively long, linear to linear-lanceolate, long-acuminate bracteoles that extend well beyond the flowers in the young buds. Its phyllode, branchlet and pod characters are those of *A. leprosa* var. *uninervia* but the bracteoles are so distinctive that the entity warrants further investigation. Typical var. *uninervia* has small, acute bracteoles and is apparently rare in New South Wales, being known only from Mount Tayar about 30 km north of Nayook Creek.

Affinities: As already noted above *A. leprosa* var. *uninervia* is closely related to the typical variety; both varieties have 1-nerved phyllodes and are distinguished (perhaps arbitrarily) by phyllode width. Variety *uninervia* is also related to *A. leprosa* var. *graveolens* which is characterised by having 2-nerved phyllodes and it might be phylogenetically closer to the New South Wales variants of var. *graveolens* (which have short, densely hairy peduncles) than to the Victorian variants of var. *graveolens* (which have longer,

sparsely hairy peduncles). Interesting and complex patterns of variation exist between these two varieties in the mountainous country to the northeast and east of Melbourne and these require further detailed study. For example, in the vicinity of Kinglake (about 20 km due W of Marysville) there occurs both the common Victorian variant of var. *graveolens* (characterised by ±sparsely appressed-hairy, relatively long peduncles and prominently 2-nerved phyllodes, see *8.R. Maslin 8584 & D.J. Murphy* and *J. Soues s.n.*) and the typical variant of var. *uninervia* (characterised by densely, ±appressed-hairy, short peduncles and prominently 1-nerved phyllodes, see *8.R. Maslin 8583 & D.J. Murphy* and *K. Macfarlane 173*). The two Maslin & Murphy specimens just listed were sympatic in a population located about 7 km east of Kinglake; no putative hybrids were detected in this population. However, in the Kinglake area there are plants that are seemingly hybrids between these two varieties, being characterised by having both 1- and 2-nerved phyllodes on the same specimen (e.g. *M.D. Tindale s.n.* collected from 11.3 km from Toolangi on the crossroads near Slide Inn, 9.i.1968, MEL 2038070, NSW 211584, PERTH; *S.K. Gardner 16*, (MELU)). Note: Specimens with densely hairy peduncles and consistently 2-nerved phyllodes also occur around Kinglake (see under var. *graveolens* for discussion). Similar complexity occurs in the Gembrook area, along the Gembrook–Tonimbuk road, where a population, represented by two separate collections made at different times, shows variation in phyllode nerve number. These collections are: *A.C. Cochrane 719 & J.C. Reid and I.C. Clarke*, 17.viii.1999, MEL2062415 and *J.C. Reid 2579*, 2.ix.2004, MEL2312550, the latter specimen has clearly 2-nerved phyllodes and is assigned to var. *graveolens*, whilst the former specimen has mostly 1-nerved phyllodes with an occassional poorly developed second nerve on some phyllodes and is assigned to var. *uninervia*. The apparent difference in nerve number in this population over time may flag developmental differences in phyllode nerve number from younger to older plants. A difference in phyllode nerve number has previously been noted in juvenile versus mature *Acacia stricta* phyllodes (Gardner et *al.* 2005).

Etymology: The variety name is derived from the Latin *unicus* (singular) and *nervus* (nerve) in reference to the prominently 1-nerved phyllodes.

2c. *Acacia leprosa* var. *graveolens* Maslin & D.J.Murphy, *var. nov.*

Frutices (1–)2–6 m alti vel interdum (in Tasmania) *arbores* ad 8 m alta. *Ramuli* tenuiter costati, costis plerumque sparse vel modice appresse-puberulis. *Phyllodia* (30–)50–110 mm longa, (3–)7–20(–30) lata, puncticulata, *nervis longitudinalibus* 2in quoque facies positis. *Glans* plerumque ad extremum pulvini posita, (1–)2–4 mm supra pulvinum in Kinglake-Marysville forma. *Inflorescentiae* plerumque simplices immixtae cum racemis rudimentaribus; *pedunculi* (3–)4–8(–11) mm longi, sub-glabri vel modice (dense) ±appresse puberuli; bractea basalis peduncularis mature caduca. *8racteolae* 1(–1.5) mm longae, acutae vel interdum acuminatae. *Flores* 5-meri; calyx breviter lobatus. *Legumina* linearia vel anguste oblonga, 30–90 mm longa, 4–6 mm lata. *Semina* in leguminibus longitudinaliter ordinata, arillata

Shrubs (1–)2–6 m tall or sometimes (in Tasmania) *trees* to 8 m tall. *8ranchlets* finely ribbed, the ribs normally sparsely to moderately appressed-puberulous. *Phyllodes* (30–)50–110 mm long and (3–)7–20(–30) mm wide, puncticulate; with 2 *longitudinal nerves* on each face. *Gland* usually at distal end of pulvinus, (1–)2–4 mm above the pulvinus in the Kinglake–Marysville variant. *Inflorescences* normally simple intermixed with rudimentary racemes; *peduncles* (3–)4–8(–11) mm long, sub-glabrous to moderately (densely) ±appressed-puberulous; *basal peduncular bract* early caducous. *8racteoles* 1(–1.5) mm long, acute or sometimes acuminate. *Flowers* 5-merous; calyx shortly lobed. *Pods* linear to narrowly oblong, 30–90 mm long, 4–6 mm wide. *Seeds* longitudinal in pods, arillate.

Type: Gippsland Lakes, carpark below summit of Mt Elizabeth No. 2, Mt Elizabeth State Forest, Victoria, 14.xi.1986, *D.E. Albrecht 2876*; *holotype*: MEL 2079232; *isotypes*: BRI, PERTH.

Acacia graveolens Lodd., *Bot. Cab.* 15: t. 1460 (1828); G. Don, Gen. hist. 2: 404 (1832). *Type citation*: "a native of New Holland [Australia], introduced in 1820". *Type. n.v.*

Acacia verniciflua (southern variant) sensu T.J. Entwisle et *al.*, *Fl. Victoria* 3: 618 (1996).

Acacia verniciflua second variant sensu B.R. Maslin, *Fl. Australia* 11A: 597 (2001).

Acacia verniciflua var. *graveolens* [as 'Graveolens'] (D.E.Albrecht 1883) Vic Herbarium, Australian Plant Census CHAH (2006).

Illustrations. W.J. Hooker, Bot. Cab. 15: t. 1460 (1828); T.J. Entwisle *et al. Fl. Victoria* 3: 615, fig. 124I (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84H (2001).

Often somewhat spindly *shrubs* (1–)2–6 m tall, sometimes (in Tasmania) *trees* to 8 m tall, normally 1- or 2-stemmed with a sparse crown. *Phyllodes* normally (40–)50–110 mm long and (5–)7–20(–30) mm wide, occasionally 30–40 mm long and 3–4 mm wide in Tasmania; with 2 *longitudinal nerves*, the nerves of equal prominence or the adaxial one slightly less pronounced than the abaxial one; *lateral nerves* obscure or quite evident. *Gland* usually at distal end of pulvinus, ±circular to oblong and c. 0.5 mm long, (1–)2–4 mm above the pulvinus and elongated in the Kinglake–Marysville variant. *Peduncles* (3–)4–8(–11) mm long, normally sub-glabrous to moderately appressed to sub-appressed hairy (occasionally interspersed with a few patent hairs), sometimes densely appressed-hairy; *basal peduncular bract* early caducous, 1–2 mm long. *Bracteoles* not or scarcely visible in mature buds being over-topped by the flowers, spathulate, 1(–1.5) mm long (equal to, or slightly exceeding, length of calyx), the laminae ±equal to length of claws and acute, sometimes acuminate. Fig. 11.

Selected specimens examined: **Typical variant. NEW SOUTH WALES:** Coolangubra State Forest, Big Jack fire trail, c. 1 km NW of the summit of Big Jack Mountain, 21.x.1986, *D.E. Albrecht 292B* (MEL, NSW); Brown's Gap, Lithgow, 10.x.1961, *C. Burgess s.n.* (CANB 001586); Ruby Creek, Mt Werong, *L.A.S. Johnson & E.F. Constable s.n.* (NSW 19460); 1.6 km N of Bindook Gap, 55 km SW of Katoomba, 16.ix.1967, *R.G. Coveny s.n.* (MEL 118360, NSW 148473); Tumut State Forest, 24.v.1979, *J. Johnson s.n.* (NSW); Mount Shivering (E of Mount Werong), 18.ix.1967, *A.N. Rodd 529* (NSW). **VICTORIA:** 2.2 km by road from Erica township towards Walhalla, 25.ix.1985, *D.E. Albrecht 1883* (MEL); Gippsland Lakes, carpark below summit of Mt Elizabeth No. 2, 14.x.1986, *D.E. Albrecht 2876* (BRI, MEL, PERTH); Delegate River, Apr. 1889, *W. Baeuerlen s.n.* (NSW 374230, PERTH); c. 14 miles [22.5 km] from Ensay towards Bentley's Plain, 5.i.1969, *E.M. Canning 1477* (BRI, CANB, MEL, PERTH); Vicinity of Walhalla, 6.x.1983, *B.R. Maslin 5471* (PERTH); 2.5 km W of Melba Highway on Kinglake Road, c. 7 km E of Kinglake, 4.ix.2003, *B.R. Maslin B5B4 & D.J. Murphy* (MEL, PERTH); Kinglake, 5.x.1910, *J. Soues s.n.* (MEL 1528947). **TASMANIA:** 20 miles [32 km] W of St Helens, 10.i.1949, *N.T. Burbidge 3081* (HO, ex CANB); Styx River road (near Maydena), 4.ii.1969, *E.M. Canning s.n.* (CANB, HO, K, MEL, MO); Tasman Highway S of Gray, 18.ix.1988, *P. Collier 3355* (HO); St Columbia Falls, 30.iv.1984, *R. Cumming 3441* (PERTH); Hobart, 7.ii.1819, *A. Cunningham 125* (K); Mt Victoria, 1.v.1980, *M.G. Noble 29266* (HO); Hobart, 1842, *R. Gunn 479* (NSW); Cascades, Hobart, 15.x.1899, *L. Rodway 199* (HO). **Kinglake–Marysville variant. VICTORIA:** Upper Yarra Park [Healesville district], 37°39'S, 145°53'E, 25.xi.1982, *A.C. Beauglehole 71774A & C.M. Beardsell* (MEL); Mt Slide, 4 miles (6.4 km) E of Kinglake, 6.v.1972, *A.B. Court & M.D. Tindale 800* (CANB, K, MEL, NSW, US *n.v.*); Cumberland Falls reserve, c. 9 miles [16 km] ESE of Marysville, 26.ix.1962, *C. Harding Browne s.n.* (MEL 1S29097, PERTH 01493221). **Stanthorpe variant. QUEENSLAND:** Stanthorpe, *G. Ward s.n.* (BRI 52201, NSW 255307, PERTH 04558367). **Small phyllode variant. TASMANIA:** Levendale, 1.x.1996, *A.M. Buchanan 142B7* (HO); near summit of Rogers Lookout, adjacent to Skyline Tier Road, 15.i.1991, *A.M. Gray 741* (CANB, HO); near summit of Rogers Lookout, adjacent to Skyline Tier Road, 15.i.1991, *A.M. Gray 742* (CANB, HO).

Distribution and habitat: Occurs along the Great Dividing Range from south-east Queensland (Stanthorpe), then the Mount Werong area east of Sydney, New South Wales, with scattered occurrences further south in New South Wales (including the Tumut State Forest) to north-east and east of Melbourne in Victoria; it also occurs in Tasmania. Grows in tall *Eucalyptus* forest. Fig. 10B.

Conservation status: Based on the widespread occurrence of this taxon and its presence in conservation reserves, *A. leprosa* var. *graveolens* is regarded as of Least Concern according to the criteria of the IUCN (LC *sensu* IUCN 2001).

Flowering and fruiting period: Flowers in mid-August to November. Pods with mature seeds have been collected from December to March.

Nomenclature: We have not been able to locate the type of *A. graveolens* Lodd., however, judging from the protologue it most likely represents the same entity as *A. leprosa* var. *graveolens*, which is described above. We considered it best to describe a new variety rather than basing our name on *A. graveolens* because we can unequivocally fix the name through the designation of a new type.

Taxonomy: Variety *graveolens* is the most widespread and common variety of *A. leprosa* and is broadly circumscribed here to accommodate plants of this species with 2-nerved phyllodes that are not referable to the geographically restricted var. *magna*

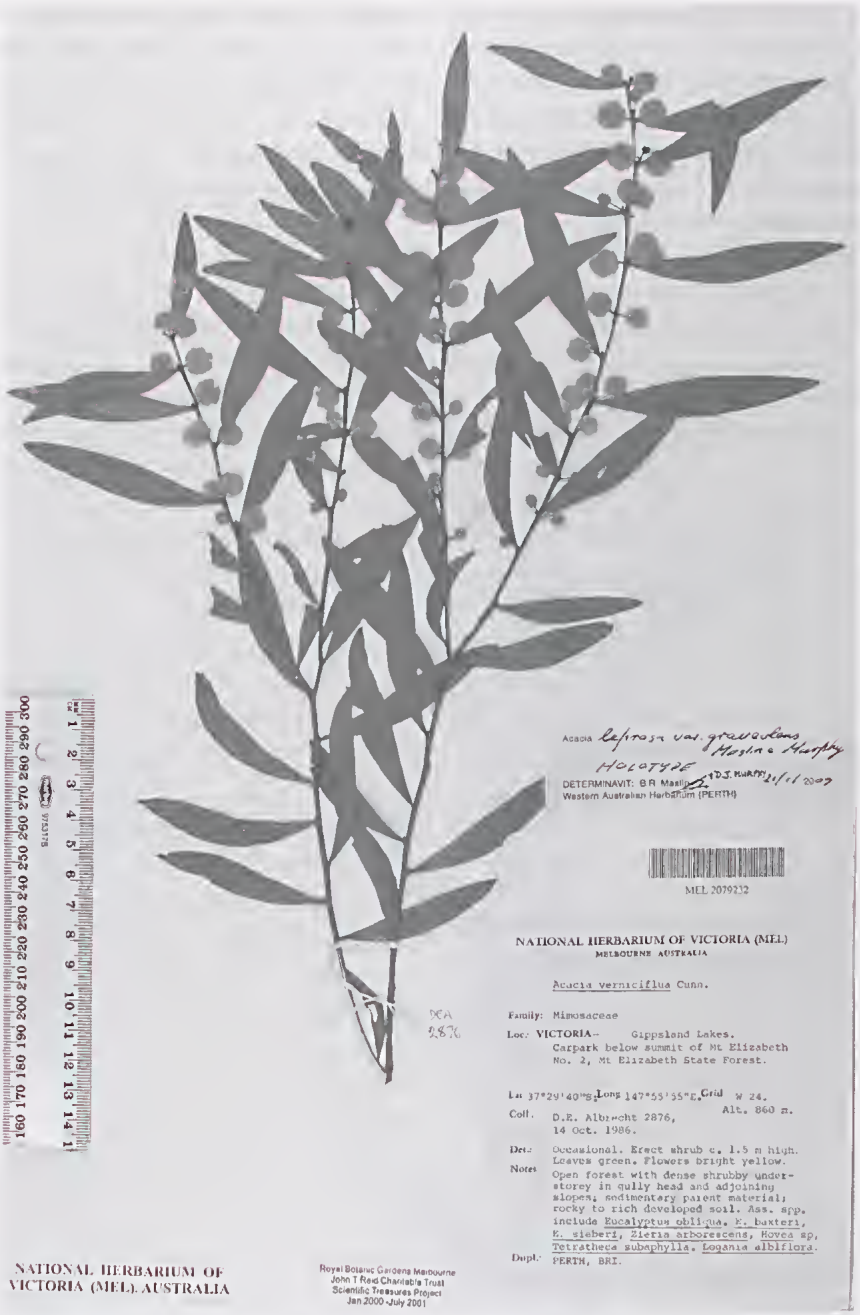
Acacia leprosa var. graveolens Maslin & Murphy
HOLOTYPE
DETERMINAVIT: B.R. Maslin
Western Australian Herbarium (PERTH)
MEL 2079232
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE AUSTRALIA
Acacia verniciflua Cunn.
Family: Mimosaceae
Loc: VICTORIA– Gippsland Lakes.
Carpark below summit of Mt Elizabeth
No. 2, Mt Elizabeth State Forest.
Lat 37°29'40"S Long 147°55'55"E Grid W 24.
Coll. D.E. Albrecht 2876, Alt. 860 m.
14 Oct. 1986.
Det.: Occasional. Erect shrub c. 1.5 m high.
Notes Leaves green. Flowers bright yellow.
Open forest with dense shrubby understorey in gully head and adjoining slopes; sedimentary parent material; rocky to rich developed soil. Ass. spp. include Eucalyptus obliqua, E. baxteri, E. sieberi, Zieria arborescens, Hovea sp, Tetratheca subaphylla, Logania albiflora.
Dupl.: PERTH, BRI.
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA
Royal Botanic Gardens Melbourne
John T Reid Charitable Trust
Scientific Treasures Project
Jan 2000 -July 2001

Figure 11. *Acacia leprosa* var. *graveolens*. Holotype (*D.E. Albrecht* 2876), herb. MEL specimen.

and var. *crassipoda*. As is discussed under *Variation* below var. *graveolens* is very variable and it is likely that future studies will attribute formal rank to some of the variants recognised here.

Variation: Phyllodes very variable in size. Normally they are about 50–110 mm long and 7–20(–30) mm wide, however, a few specimens with shorter (to about 40 mm long) or narrower (to about 5 mm wide) phyllodes occur scattered throughout the range of the species. In Tasmania some phyllodes are atypically short (30–40 mm long); these have been recorded from Levendale (about 50 km due NE of Hobart) and also from near the summit of Rogers Lookout (W of St Helens, about 150 km N of Levendale). The phyllodes

on these short phyllode Tasmanian plants may be atypically narrow (3–4 mm wide) or within the normal width range for the variety (7–12 mm wide) and these two forms may co-occur (compare *A.M. Gray 741* – broad phyllodes with *A.M. Gray 742* – narrow phyllodes). Plants with the largest stature occur in Tasmania where they are sometimes trees 6–8 m tall (but the normal shrub forms also occur in that state).

The peduncles on plants of *A. leprosa* var. *graveolens* from New South Wales are generally slightly shorter [3–4(–5) mm long] and with a denser indumentum than plants from Victoria, and their phyllodes are normally 50–70 mm long (often above 70 mm in Victoria). The New South Wales plants are variable with respect to their phyllode width with the widest ones found on plants from Brown's Gap near Lithgow (see *C. Burgess s.n.*). Apart from the Kinglake–Marysville variant referred to below, the peduncles on plants of var. *graveolens* in Victoria are normally sparsely to moderately, appressed to sub-appressed hairy. A few plants of this variety from Tasmania also have densely hairy peduncles.

There is a single collection (in young bud) from the granite country around Stanthorpe, Queensland (see citation above). These specimens are unusual in having clearly patent hairs on their relatively long peduncles, and acuminate bracteoles. They seem otherwise to be typical of the more southerly occurring var. *graveolens*.

Plants with similar acuminate bracteoles occasionally occur around Mount Werong in New South Wales but their peduncles are typical of other New South Wales plants of this variety in being 3–4 mm long and appressed-hairy, e.g. *L.A.S. Johnson & E.F. Constable* s.n. (NSW 19460). The bracteoles on most other New South Wales plants are acute, not acuminate. Mount Werong is an area that would benefit from further study. Apart from the plants just mentioned typical var. *graveolens* (acute bracteoles), var. *uninervia* and a possible hybrid between var. *graveolens* and var. *leprosa* (see below) occur in this area.

There are a few specimens from the Kingslake–Marysville area in Victoria (listed above) that are provisionally referred to *A. leprosa* var. *graveolens*. These plants resemble the typical form of the variety in having wide, 2-nerved phyllodes but differ most obviously from other Victorian plants of var. *graveolens* in their densely hairy peduncles (hairs patent or appressed) and their phyllodes which have a clearly elongated gland that is located (1–)2–4 mm above the pulvinus (in typical var. *graveolens* the gland is ±circular to oblong and located at the distal end of the pulvinus). The relationship of these plants to *A. leprosa* var. *crassipoda* and to the large bracteole variant of *A. leprosa* var. *uninervia* requires further study.

Hybridity: A possible hybrid between *A. leprosa* var. *graveolens* and var. *leprosa* is represented by two specimens, *B.G. Briggs s.n.* (NSW 167431) and *W.F. Blakely & F.J. Ludowici s.n.* (NSW 27535). These specimens have rather narrow phyllodes (5–7 mm wide) that are both 1- and 2-nerved on the one plant. The closest records of var. *leprosa* to Mount Werong are from about 50 km to the south-east (from Hill Top, near Mittagong). As already noted, *A. leprosa* var. *uninervia* (phyllodes 1-nerved) also occurs at Mount Werong.

Etymology: The varietal name is derived from the Latin *graveolens* (strong-smelling). The name was first used by Loddiges (1828) who described this taxon as a species based on a plant in horticulture in England; he described them as having a 'powerful and unpleasant' smell but we have not assessed this odour in nature.

2d. *Acacia leprosa* var. *magna* Maslin & D.J.Murphy, *var. nov.*

Frutices ad 3 m alti, vel interdum *arbores* ad 10 m alta. *Ramili* tenuiter costati, costis plerumque sparse vel modice appresse-puberulis. *Phyllodia* 80–130 mm longa, (12–)15–20(–30) lata, puncticulate; *nervis longitudinalibus* prominentibus 2 in quoque facies positis. *Glans* ad extremum pulvini posita, circularis. *Inflorescentiae* plerumque simplices immixtae cum racemis rudimentaribus; *pedunculi* 4–6 mm longi, sub-glabri vel ± puberuli; *bractea basalis pedunculares* persistens, prominens (3–4 mm longa). *Bracteolae* in gemma perspicue manifestae, lanceolatae, c. 2 mm longae, acuminatae. *Flores* 5-meri; *calyx* breviter lobatus. *Legumina* non visa.

Shrubs to 3 m tall or sometimes *trees* to 10 m. *Branchlets* finely ribbed, the ribs normally sparsely to moderately appressed-puberulous. *Phyllodes* 80–130 mm long, (12–)15–20(–30) mm wide, puncticulate; with 2, prominent *longitudinal nerves* on each face. *Gland* situated at distal end of pulvinus, circular. *Inflorescences* normally simple intermixed with rudimentary racemes; *peduncles* 4–6 mm long, sub-glabrous to sparsely ±puberulous;

basal peduncular bract persistent, prominent (3–4 mm long). *Bracteoles* clearly evident in buds, lanceolate, c. 2 mm long, acuminate. *Flowers* 5-merous; calyx shortly lobed. *Pods* not seen.

Type: Lardners Track, South Gellibrand, Cape Otway, Victoria, 21.ix.1963, *R. Filson 5317*; *holotype*: MEL 37874; *isotype*: BRI.

Shrubs to 3 m tall or sometimes *trees* to 10 m, sometimes single-stemmed; branchlets rarely pruinose. *Phyllodes* 80–130 mm long, (12–)15–20(–30) mm wide; with 2, prominent *longitudinal nerves* of equal prominence. *Gland* often indistinct, situated at distal end of pulvinus, circular. *Peduncles* 4–6 mm long, sub-glabrous to ±sparsely and minutely appressed or sub-appressed

Figure 12. *Acacia leprosa* var. *magna*. Holotype (*R. Filson* 5317), herb. MEL specimen.

puberulous with straight hairs; *basal peduncular bract* prominent and persistent to anthesis, 3–4 mm long, cleft at apex. *Bracteoles* clearly evident in buds and overtopping the flowers, lanceolate, c. 2 mm long (as long as, or slightly exceeding, the petals), the laminae large (much longer than the very short claws), acuminate, appressed-hairy and 1-nerved abaxially. *Pods* not seen. Fig. 12.

Other specimens examined: **VICTORIA:** Anglesea, Gum Flats Road, 30.x.2005, *R.J. Adair s.n.* (MEL 2292814); Otway Ranges, 5 km SW of Carlisle River, 31.viii.1986, *P.F. Barnett 173* (MEL); Otway Ranges, W of Lavers Hill, 14.xi.1959, *A.C. Beauglehole 18973* (MEL); Angahook–Lorne State Park, Erskine Creek, 28.vii.1996, *J.W. Grimes 33B2 & B. Meurer-Grimes* (MEL); 11 miles [17.6 km] from Apollo Bay towards Beech Forest (via Ocean Road), 14.xi.1970, *P. McDonnell 383* (MEL); 32 km SW of Colac, Colac–Lavers Hill road, 27.v.1997, *P.G. Neish 271* (MEL).

Distribution and habitat: Endemic in Victoria where it occurs from the Otway Plain at Anglesea, scattered through the Otway Ranges to as far west as Carlisle River. This variety grows on mesic hillsides in tall wet sclerophyll forest or rainforest near creeks. Fig. 13A.

Conservation status: *Acacia leprosa* var. *magna* has a restricted known distribution and is regarded as Vulnerable according to the criteria of the IUCN (VU Ba, biii *sensu* IUCN 2001).

Flowering and fruiting period: Flowers from September to November. Fruiting specimens have not been seen.

Taxonomy: Variety *magna* is unique within *A. leprosa* in having large, persistent basal peduncular bracts. There are other varieties of *A. leprosa* that occur within the geographic range of var. *magna*.

Affinities: Most closely related to Victorian forms of *A. leprosa* var. *graveolens* that have large, 2-nerved phyllodes and sparsely appressed-hairy peduncles. Variety *magna* is, however, readily distinguished by its large, persistent basal peduncular bracts and large, lanceolate, acuminate bracteoles. Although the lanceolate to narrowly elliptic phyllodes are normally narrowed to acute or acuminate apices they are occasionally obtuse (with a central mucro) and in these cases var. *magna* may superficially resemble *A. rostriformis* which occurs around Bacchus Marsh, about 100 km to the north-east. *Acacia rostriformis* is most readily distinguished by its generally smaller phyllodes with rostriform, excentrically mucronate apices, longer peduncles with a denser indumentum and smaller basal bracts, and smaller, acute bracteoles.

Figure 13. Distribution maps for: **A.** *Acacia leprosa* var. *magna*; **B.** *A. leprosa* var. *crassipoda*.

Variation: One specimen with pruinose branchlets has been seen (*A.C. Beauglehole 18973*) but it is not known how common this attribute is within the variety; pruinose branchlets are otherwise not known within *A. leprosa*. There are not many extant specimens of this variety and there is very little habit information provided on their herbarium labels. Some labels (e.g. *P.G. Neish 271*) describe the plants as shrubs about 3 m tall, but one (*P.F. Barnett 173*) describes them as a tree 10 m tall. Similar arborescent plants occur in *A. leprosa* var. *graveolens* in Tasmania.

Etymology: The varietal name is derived from the Latin *magnus* (large) and refers to the characteristically large bracteoles and basal peduncular bracts.

2e. *Acacia leprosa* var. *crassipoda* Maslin & D.J.Murphy, *var. nov.*

Frutices graciles 1.5–3 m alti. *Ramili* tenuiter costati, costis plerumque sparse vel modice appresse-puberulis. *Phyllodia* (40–)50–90(–120) mm longa, (10–)15–20(–30) lata, puncticulate; *nervis longitudinalibus* 2 in quoque facies positis. *Glans* 0–1 mm supra pulvinum posita. *Inflorescentiae* plerumque simplices immixtae cum racemis rudimentaribus; *pedunculi* 2–4(–5) mm longi, dense puberuli-tomentulosi; *bractea basalis pedunculares* caduca. *Capitula* grandia (8–10 mm in statu sicco), (30–)35–45-flora. *Bracteolae* c. 2 mm longae, acuminatae. *Flores* 5-meri; *calyx* breviter lobatus. *Legumina* linearia vel anguste oblonga, 30–90 mm longa, 4–6 mm lata. *Semina* in leguminibus longitudinaliter ordinata, arillata.

Spindly *shrubs* 1.5–3 m tall. *Branchlets* finely ribbed, the ribs normally sparsely to moderately appressed-puberulous. *Phyllodes* (40–)50–90(–120) mm long, (10–)15–20(–30) mm wide, puncticulate; with 2 *longitudinal nerves* on each face. *Gland* 0–1 mm above the pulvinus. *Inflorescences* normally simple intermixed with rudimentary racemes; *peduncles* 2–4(–5) mm long, densely puberulous-tomentulose; *basal peduncular bract* caducous. *Heads* large (8–10 mm diam. when dry), (30–)35–45-flowered. *Bracteoles* c. 2 mm long, acuminate. *Flowers* 5-merous; calyx shortly lobed. *Pods* linear to narrowly oblong, 30–90 mm long, 4–6 mm wide. *Seeds* longitudinal in pods, arillate.

Type: Pyrenees Range, c. 8 km W of Avoca, on road to Lookout No. 3, 2 km NW of Vinoca Road, 3.ix.2004, Victoria, *B.R. Maslin 8576 & D.J. Murphy*; *holotype*: MEL 2212578; *isotypes*: CANB, K, PERTH.

Spindly *shrubs* 1.5–3 m tall. *Phyllodes* (40–)50–90 (–120) mm long, (10–)15–20(–30) mm wide; with 2 *longitudinal nerves* of ±equal prominence; *lateral nerves* fine but reasonably evident when dry. *Gland* 0–1 mm above the pulvinus, circular or elongated. *Peduncles* 2–4(–5) mm long, often obscured by stamens at anthesis so that the heads superficially look sessile, densely puberulous-tomentulose with somewhat matted, ±appressed to widely spreading, straight to shallowly curved or sub-crisped hairs; *basal peduncular bract* caducous, 1.5–2(–3) mm long. *Heads* large (8–10 mm diam. when dry), (30–)35–45-flowered. *Bracteoles* visible (but not prominent) in mature buds, usually lanceolate, c. 2 mm long (exceeding the calyx but slightly shorter than the corolla), the laminae distinctly acuminate and longer than the claws (but see note under *Variation* below). Plates 1 & 2. Fig. 14.

Selected specimens examined: **VICTORIA:** upper source of Glenelg River, Victoria Range, Grampians, 25.ii.1957, *A.C. Beauglehole 4667* (MEL); about 12 km W of Avoca P.O., 19.viii.1975, *A.C. Beauglehole 50246* (BRI, MEL); base of Mount White, Grampians, without date, *Joshuas s.n.* (NSW 258341 – bracteoles smaller than normal); 5.6 km from Mt William car park, 20.i.1997, *P.G. Neish 88 & A.M. Muasya* (MEL, MELU); Mount William Road, c. 4 km towards summit from Grampians Road, 22.x.1996, *A. Paget 2549* (MEL – bracteoles smaller than normal); The Pyrenees, Percydale historic area, Mt Avoca Tourist Road, c. 3 km WSW of the lookout, 11.x.2003, *V. Stajsic 3374 & K. Rule* (MEL); just W of Mountain Hut Track at a point c. 7 km from Pyrenees Hwy, c. 2.5 km SE of Mt Avoca, 23.ix.2005, *N.G. Walsh 6415, J.A. Jeanes & H. Rommelaar* (MEL).

Distribution and habitat: Endemic in Victoria where it occurs in the Grampian Range (recorded from Mount William, Mount White and the Victoria Range) and about 50 km to the east, from the Pyrenees Range which is located to the west of Avoca. Variety *crassipoda* grows in steep mountainous country in eucalypt forest, and occurs in a series of small disjunct populations. It grows in clay soils over sandstone or shale. Fig. 13B.

Flowering and fruiting period: Flowers from late August to November. Pods with mature seeds have been collected in January and February.

Taxonomy: This is the least distinctive of the varieties of *A. leprosa* but is recognised by a combination of the

following characters: broad, 2-nerved phyllodes (but these characters are not unique to var. *crassipoda*), short, stout, densely hairy peduncles (see discussion below), large heads with normally numerous flowers (head 8–10 mm diam. when dry and normally 35–45-flowered; in most other varieties of *A. leprosa* the heads do not exceed 8 mm diam. when dry and are normally 20–35-flowered) and with normally distinctly acuminate bracteoles (but see discussion below).

The peduncles in var. *crassipoda* are distinctively densely hairy, short (often obscured by the filaments at anthesis so that the heads often appear superficially sessile) and seemingly stout (about 1 mm wide). In actuality the peduncle width is about the same as in

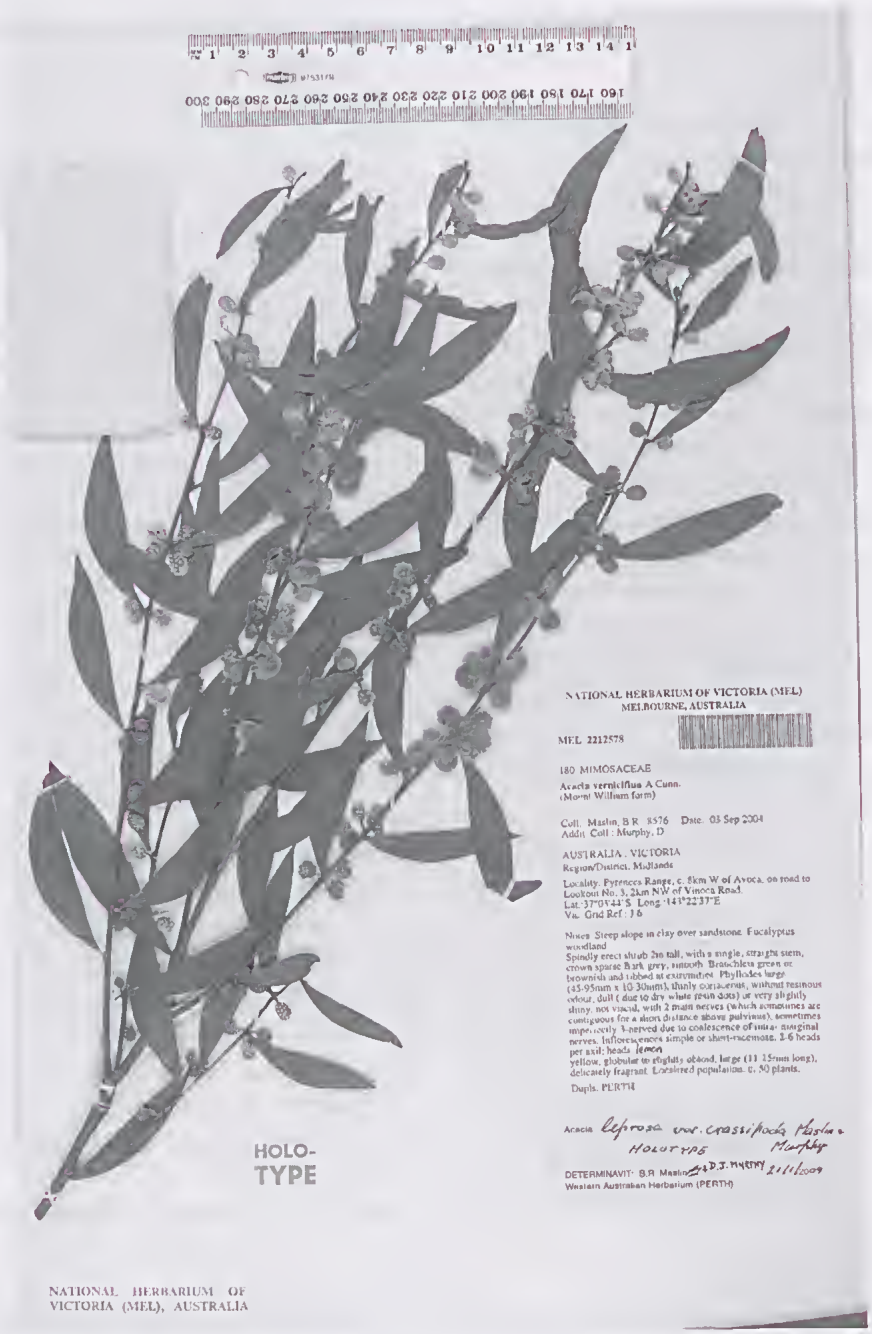
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2212578
180 MIMOSACEAE
Acacia verniciflua A.Cunn.
(Mount William form)
Coll. Maslin, B.R. 8576 Date. 03 Sep 2004
Addit. Coll : Murphy, D
AUSTRALIA : VICTORIA
Region/District. Midlands
Locality. Pyrenees Range, c. 8km W of Avoca, on road to Lookout No. 3, 2km NW of Vinoca Road.
Lat. 37°09'44"S Long. 143°22'37"E
Vic. Grid Ref. : J 6
Notes Steep slope in clay over sandstone. Eucalyptus woodland
Spindly erect shrub 2m tall, with a single, straight stem, crown sparse. Bark grey, smooth. Branchlets green or brownish and ribbed at extremities. Phyllodes large (45-95mm x 10-30mm), thinly coriaceous, without resinous odour, dull (dust to dry white resin-dots) or very slightly shiny, not viscid, with 2 main nerves (which sometimes are contiguous for a short distance above pulvinus), sometimes imperfectly 3-nerved due to coalescence of inter-marginal nerves. Inflorescences simple or short-racemose. 2-6 heads per axil; heads lemon yellow, globular to slightly obtend, large (11-15mm long), delicately fragrant. Localised populations. c. 50 plants.
Dupls. PERTH
Acacia leprosa var. crassipoda Maslin & Murphy
HOLOTYPE
DETERMINAVIT: B.R. Maslin & D.J. Murphy 21/1/2009
Western Australian Herbarium (PERTH)
HOLO-
TYPE
NATIONAL HERBARIUM OF
VICTORIA (MEL), AUSTRALIA

Figure 14. *Acacia leprosa* var. *crassipoda*. Holotype (*B.R. Maslin 8576 & D.J. Murphy*), herb. MEL specimen.

the other varieties of *A. leprosa* (c. 0.5 mm wide) but they appear wider being covered by a thick layer of sometimes ±matted hairs.

Variation: The bracteoles are normally about 2 mm long (clearly longer than the calyx, but slightly shorter than the petals) with clearly acuminate laminae that are longer than the short claws. These distinctive bracteoles occur elsewhere in *A. leprosa* but are uncommon (they occur in var. *magna* and in the large bracteole variant of var. *uninervia*). In var. *crassipoda* we have seen two atypical specimens (*A. Paget 2549* and *Joshuas s.n.)* that have slightly shorter than normal bracteoles (1.2–1.5 mm long) with short-acuminate laminae that are equal in length to the claws; the *A. Paget 2549* is further atypical in having few-flowered heads, c. 25. These two specimens appear otherwise typical of var. *crassipoda*; they occur in the Grampians within the geographic range of the variety.

The phyllodes in *A. leprosa* var. *crassipoda* are normally gradually narrowed to acute or acuminate apices but on *V. Stajsic 3374 & K. Rule* they are abruptly narrowed to obtuse apices (with a central mucro) and as such superficially resemble those of *A. exudans* (from around Casterton) or *A. rostriformis* (from around Bacchus Marsh). *Acacia exudans* is most readily distinguished by its glabrous branchlets that are marked with broad, flat bands (like those of *A. verniciflua*) whereas the branchlets on *V. Stajsic 3374 & K. Rule* are marked with distinctly raised, appressed-hairy ribs. *Acacia rostriformis* is distinguished from var. *crassipoda* by its narrower phyllodes (mostly 5–10 mm wide) with a distinctive, excentric mucro and generally longer peduncles (mostly 5–9 mm) with persistent basal bracts (phyllodes normally 15–20 mm long with a centric mucro and peduncles 2–4(–5) mm long with caducous basal bracts in var. *crassipoda*).

Affinities: Variety *crassipoda* is most closely related to *A. leprosa* var. *graveolens* (2-nerved phyllodes) which is normally recognised by having longer (4–8 mm), more sparsely hairy peduncles and small bracteoles (about 1 mm long) with the acute laminae ±equal in length to the claws. There is, however, a variant of var. *graveolens* from the Kinglake–Marysville area that has densely hairy, rather short (4–5 mm long) peduncles; these plants superficially resemble var. *crassipoda* but are distinguished most readily by their clearly elongated glands which are normally 2–4 mm above the pulvinus (gland 0–1 mm above pulvinus in var. *crassipoda*).

Conservation status: *Acacia leprosa* var. *crassipoda* occurs in less than five known locations and its range is highly fragmented. Therefore this taxon is regarded as Vulnerable according to the criteria of the IUCN (VU Ba, biii *sensu* IUCN 2001). However, enhanced surveys for this taxon based on its known habitat preferences may discover additional populations.

Etymology: The varietal name is derived from the Latin *crassus* (thick) and *poda* (foot) in allusion to the short, stout peduncles.

3. *Acacia rostriformis* Maslin & D.J.Murphy, *sp. nov.*

Frutices 1–6(–8) m alti. *Ramili* manifeste costati, costis appresse-puberulis. *Phyllodia* anguste elliptica vel oblongo-elliptica, plerumque oblanceolata vel ±lanceolata, 20–45(–60) mm longa, (3–)5–10(–13) mm lata, puncticulate; *nervis longitudinalibus* 2 in quoque facies positis; *apices* obtusi vel sub-acuti, excentricaliter mucronati, rostriformes, saepe sub-uncinati. *Glans* 0–1 mm supra pulvinum posita. *Inflorescentiae* simplices; *pedunculi* (3–)5–9(–10) mm longi, dense tomentosi; *bractea basalis peduncularis* persistens. *Capitula* globularia vel parum obloidea, dense 25–30 flora, citrine. *Bracteolae* 0.7–1 mm longae, acutae vel brevi-acuminatae. *Flores* 5-meri; *calyx* gamosepalus, breviter lobatus. *Legumina* linearia vel anguste oblonga, 35–80 mm longa, 3–5 mm lata, tenui-texturata dense appresse-puberula in statu juvenili, indumento sparso maturitate. *Semina* in leguminibus longitudinaliter ordinata, 3.5–4.7 mm longa, arillata.

Shrubs 1–6(–8) m tall. *Branchlets* prominently ribbed, the ribs appressed-puberulous. *Phyllodes* narrowly elliptic to oblong-elliptic, sometimes oblanceolate or ±lanceolate, 20–45(–60) mm long, (3–)5–10(–13) mm wide, normally appressed-puberulous on margins and main longitudinal nerves, puncticulate; with 2 *longitudinal nerves* on each face; *apices* obtuse to sub-acute, excentrically mucronate, rostriform and often sub-uncinate. *Gland* situated 0–1 mm above pulvinus. *Inflorescences* simple; *peduncles* (3–)5–9(–10) mm long, densely tomentose; *basal peduncular bract* persistent; *heads* globular or slightly obloid, densely 25–30-flowered, lemon yellow. *Bracteoles* 0.7–1 mm long, acute to short-acuminate. *Flowers* 5-merous,

calyx gamosepalous, shortly lobed. *Pods* linear to narrowly oblong, 35–80 mm long, 3–5 mm wide, thin-textured, densely appressed-puberulous when young, indumentum sparser with age. *Seeds* longitudinal in the pods, 3.5–4.7 mm long, arillate.

Type: about 8 km due N of Bacchus Marsh, on Seereys Road, 0.3 km E of Camerons Road, Victoria, 3.ix.2004, *B.R. Maslin 8575 & D.J. Murphy*; *holotype*: MEL 2212577; *isotypes*: CANB, K, NSW, NY, PERTH.

Acacia verniciflua (*Bacchus Marsh variant*) *sensu* T.J. Entwisle *et al.*, *Fl. Victoria* 3: 618 (1996).

Acacia verniciflua fourth variant sensu B.R. Maslin, *Fl. Australia* 11A: 598 (2001).

Acacia verniciflua var. *Bacchus Marsh* (B.R. Maslin 3497) Vic Herbarium, Australian Plant Census CHAH (2006).

Illustrations. T.J. Entwisle *et al.*, *Fl. Victoria* 3: 615, fig. 124k (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84G (2001).

Slightly aromatic, obconic *shrubs* with dense rounded crowns, 1–6(–8) m tall, generally multi-stemmed from the base. *Bark* grey, smooth except fissured at base of stems on oldest plants. *New shoots* light green, slightly viscid. *Branchlets* not flexuose, angled towards extremities but aging terete, prominently ribbed, the ribs appressed-puberulous, rather broad, ±flat or more commonly raised, yellow or sometimes light green, the inter-rib region light brown to dark red-brown and not obviously resinous. *Stipules* caducous, present on young shoots only, acute, 0.5–1 mm long. *Phyllodes* narrowly elliptic to oblong-elliptic, sometimes oblanceolate or ±lanceolate, 20–45(–60) mm long, (3–)5–10(–13) mm wide, generally straight and wide-spreading, slightly shiny, not viscid, dark green, normally appressed-puberulous on margins and main longitudinal nerves, puncticulate with numerous, small, shallow, circular depressions that often exude a glistening resin (the punctae rather prominent: observe at ×10 mag.); with 2 *longitudinal nerves* on each face with the adaxial one slightly more prominent than the abaxial one, nerves not raised in fresh material but raised when dry; *lateral nerves* few and obscure; *apices* obtuse to sub-acute, excentrically mucronate, rostriform and often sub-uncinate; *pulvinus* 1 mm long, appressed-puberulous. *Gland* situated on upper margin of phyllode 0–1 mm above pulvinus, small (*c.* 0.5 mm long) and sometimes not readily observable. *Inflorescences* simple, 1–3(–5) per axil; *peduncles* (3–)5–9(–10) mm long, c. 1 mm diam., densely tomentose with short, crisped or curved, normally spreading hairs; *basal peduncular bract* persistent through flowering, brown, 2–3 mm long, navicular-cucculate, acute, sometimes apically cleft; *heads* globular or (especially in buds) slightly obloid, 9–10 mm diam. when fresh, 6–7 mm diam. when dry, densely 25–30-flowered, lemon yellow. *Bracteoles* visible but not prominent in mature buds being over-topped by flowers, spathulate, 0.7–1 mm long (about as long as the calyx), the laminae acute to short-acuminate, about as long as the claws, densely appressed-puberulous on abaxial surface and obscurely longitudinally nerved. *Flowers* 5-merous, *calyx* gamosepalous, shortly lobed. *Pods* linear to narrowly oblong, 35–80 mm long, 3–5 mm wide, firmly chartaceous to thinly coriaceous, densely appressed-puberulous when young (indumentum sparser with age), acute, marginal nerve not prominent. *Seeds* longitudinal in the pods, obloid, 3.5–4.7 mm long, 2.1–2.4 mm wide, shiny, dark brown or black; *funicle* normally twice-folded, *aril* 1.1–1.8 mm long and 1.6–2.4 mm wide. Plates 1 & 2. Fig. 15.

Selected specimens examined: **VICTORIA:** Werribee Gorge, Oct. 1945, *A.C. Beauglehole 3992B* (MEL 1528976); Lerderderg Gorge, Bacchus Marsh, May 1966, *L. Longley* FRI *13644* (CANB 00439901); between Bacchus Marsh and the Brisbane Ra., 4.xi.1973, *B.R. Moslin 3497* (CAN8, PERTH); In Australia felix [most probably collected from Bacchus Marsh], Sep. 1852, *F. Mueller 49* (MEL 1528987); Bacchus Marsh, Jan. 1853, *F. Mueller s.n.* (MEL 1529009); Ex horto Bot. Melb. [cultivated, Royal Botanic Gardens, Melbourne], 1863, *F. Mueller s.n.* (MEL 1529053); near Balliang, 22.vii.1968, *N. Scorlett s.n.* (CANB 028558); Werribee, Werribee River, reserve between the west end of Redgum Close and the Southern Water Diversion Weir, 3.x.2006, *V. Stojsic 4163 & N. Korunojeewo & Werribee River Association* (MEL); Goodman's Creek, near Coimadai, N of Bacchus Marsh, 17.ix.1945, *J.H. Willis s.n.* (MEL 1011069).

Distribution and habitat: Endemic in Victoria where it is confined to a small area around Bacchus Marsh (Lerderderg Gorge, Long Forest Nature Conservation Reserve, Coimadai and Balliang) with an outlier population from Werribee. *Acacia rostriformis* occurs as discontinuous populations within a region that has been extensively cleared for agriculture, but it is common in the places where it is found. It grows in low hilly country on brown clay in *Eucalyptus* woodland. Fig. 16A.

Conservation status: *Acacia rostriformis* is found in a limited number of reserves and may be regarded as depleted in its former natural range. This taxon is regarded as Vulnerable according to the criteria of the IUCN (VU C1 *sensu* IUCN 2001), although it is possible that future survey work will identify additional populations.

Flowering and fruiting period: Flowers from late August to early October with the main flush in September. Because of the paucity of fruiting material it is difficult to accurately determine when seed is produced, however, it is probable that plants with mature pods would occur from about December to February.

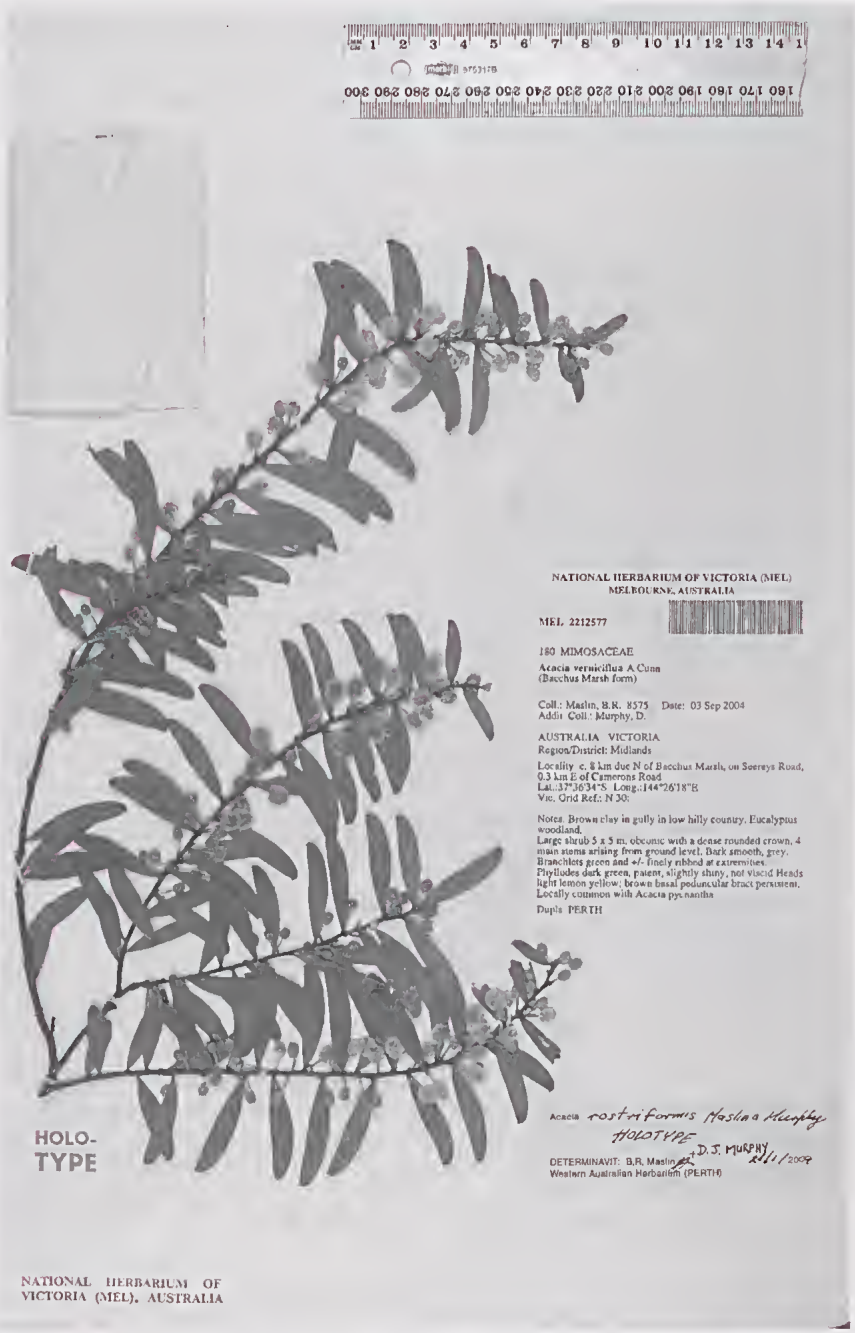
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2212577
180 MIMOSACEAE
Acacia verniciflua A.Cunn
(Bacchus Marsh form)
Coll.: Maslin, B.R. 8575 Date: 03 Sep 2004
Addit Coll.: Murphy, D.
AUSTRALIA VICTORIA
Region/District: Midlands
Locality c. 8 km due N of Bacchus Marsh, on Seerays Road, 0.3 km E of Camerons Road
Lat.:37°36'34"S Long.:144°26'18"E
Vic. Grid Ref.: N 30:
Notes Brown clay in gully in low hilly country. Eucalyptus woodland.
Large shrub 5 x 5 m, obconic with a dense rounded crown, 4 main stems arising from ground level. Bark smooth, grey. Branchlets green and +/- finely ribbed at extremities
Phyllodes dark green, patent, slightly shiny, not viscid Heads light lemon yellow; brown basal peduncular bract persistent. Locally common with Acacia pycnantha
Dupls PERTH
HOLO-
TYPE
Acacia rostriformis Maslin & Murphy
HOLOTYPE
D.J. MURPHY 22/1/2009
DETERMINAVIT: B.R. Maslin
Western Australian Herbarium (PERTH)
NATIONAL HERBARIUM OF
VICTORIA (MEL), AUSTRALIA

Figure 15. *Acacia rostriformis.* Holotype (*B.R. Maslin* 8575 & *D.J. Murphy*), herb. MEL specimen.

Affinities: *Acacia rostriformis* is unique among the species dealt with in this paper in having rostriform, excentrically mucronate phyllode apices and densely hairy pods (at least when young). It appears to be most closely related to *A. exudans* (which grows around Casterton, about 300 km to the east of where *A. rostriformis* occurs) on account of having 2-nerved phyllodes and densely tomentose peduncles (see *A. exudans* for differences). *Acacia leprosa* var. *crassipoda* also has 2-nerved phyllodes and a similar peduncle indumentum (see var. *crassipoda* for differences); this variety grows in the Pyrenees Range west of Avoca (about 150 km northeast of Bacchus Marsh) and in the Grampian Range further west.

Notes: The normally yellow branchlet ribs on the penultimate branchlets in *A. rostriformis* are broad and sometimes not dissimilar to the 'bands' that occur in *A. exudans* and *A. verniciflua*; however, in *A. rostriformis* these structures are more commonly obviously raised (low-profile and flat in the other two species) and are always invested with an indumentum comprising appressed hairs (glabrous in *A. exudans* and *A. verniciflua*).

It is rather surprising that there are relatively few contemporary collections of this species. It grows only about 50 km east of Melbourne and although it has a restricted distribution near Bacchus Marsh and Werribee it is common in the places where it occurs and is very showy when in flower. The first collection of this species was that of Mueller in September 1852 (MEL 1528987); although this specimen is without a precise locality it was almost certainly collected from Bacchus Marsh. In January 1853 Mueller again collected *A. rostriformis* and this specimen (MEL 1529009) is labelled as having been collected from Bacchus Marsh. Mueller seemingly considered the species to have had horticultural significance because there is a specimen of his taken from a plant grown at the Royal Botanic Gardens, Melbourne in 1863 (MEL 1529053). In all likelihood this cultivated plant was grown from seed collected by Mueller in January 1853. Most of the early collections of this species were named *A. exudans* which is now known to be a distinct, but closely related, species.

Common name: Bacchus Marsh Wattle

Etymology: The species name is derived from the Latin *rostrum* (a beak) and *forma* (shape) in allusion to the distinctive, obtuse to sub-acute and excentrically mucronate phyllode apices that often resemble a bird's head in profile.

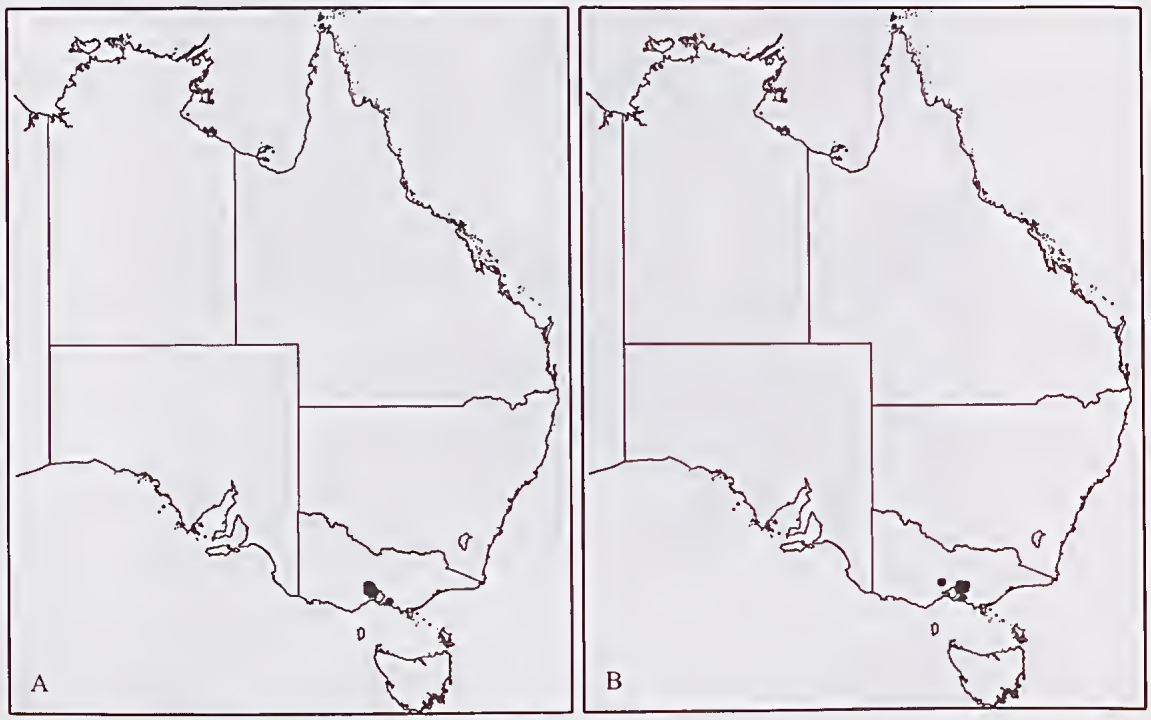

Figure 16. Distribution maps for **A.** *Acacia rostriformis*; **B.** *A. stictophylla*.

4. *Acacia stictophylla* Court ex Maslin & D.J.Murphy, *sp. nov.*

Frutices aromatici, 2–4 m alti. Ramili tenuiter costati, costis glabris vel sparse appresse-puberulis. *Phyllodio* anguste elliptica vel lanceolato-elliptica, raro ±linearia, (40–)50–90(–100) mm longa, (2–)3–6(8–12) mm lata, tenui-texterata, atro-viridia, glabra vel costa et margine sparse appresso puberuli, puncticulate; *nervo longitudinoli* 1 in quoque facies posito; *opices* acuti vel brevi-acuminati,interdum obtuso mucronati. *Glons* supra marginem phyllodii posita, 0(–0.5) mm supra pulvinum.*Inflorescentio*eplerumquesimplices;*pedunculi* 4–8(–10) mm longi, modice dense et aliquantum laxe pubescentes; *broctea bosolis pedunculoris* caduca vel interdum persistens. *Capitula* globularia sed gemmae plerumque obloidea, 30–50-flora, citrina. *Brocteolae* trans flores exsertae in statu juvenili, 1.2–1.5 mm longae, acuminatae vel brevi-acuminatae. *Flores* 5-meri; *colyx* gamosepalus, breviter lobatus. *Legumino* linearia, 20–60 mm longa, 3–4 mm lata, chartacea, glabra vel sparsissima appresse-puberula. *Semina* in leguminibus longitudinaliter ordinata, arillata.

Aromatic *shrubs* 2–4 m tall. *Branchlets* finely ribbed, the ribs glabrous or very sparsely appressed-puberulous. *Phyllodes* narrowly elliptic to lanceolate-elliptic, rarely ±linear, (40–)50–90(–100) mm long, (2–)3–6(8–12) mm wide, thin-textured, dark green, glabrous or sparsely appressed-puberulous on mid-rib and margin, puncticulate; with 1 *longitudinol nerve* on each face; *opices* acute to short-acuminate, sometimes obtuse-mucronate. *Gland* situated on upper margin of phyllode 0(–0.5) mm above the pulvinus, not prominent. *Inflorescences* normally simple; *peduncles* 4–8(–10) mm long, moderately densely and rather loosely pubescent; *basol peduncular bract* caducous or sometimes persistent; *heads* globular but often obloid in bud, 30–50-flowered, lemon yellow. *Brocteoles* exserted beyond flowers when young, 1.2–1.5 mm long, acuminate to short-acuminate. *Flowers* 5-merous; *colyx* gamosepalous, shortly lobed. *Pods* linear, 20–60 mm long, 3–4 mm wide, chartaceous, glabrous to very sparsely appressed-puberulous. *Seeds* longitudinal in the pods, arillate.

Type: Dandenong Range east of Melbourne, on Belgrave–Gembrook road due NE of Belgrave township just N of Black Hill road, Victoria, 27.viii.1985, *B.R. Moslin 5868*; *holotype*: MEL 712039; *isotypes*: CANB, K, NSW, NY, PERTH.

Acocio leproso var. *elongata* Guilf., Austral. Pl. 34, 403, pl. (1911), *nom. invol.* (description not diagnostic).

Acocio leproso (Dondenong Ronge voriant) sensu T.J. Entwisle *et al., Fl. Victorio* 3: 620 (1996).

Acacio leproso second voriont sensu B.R. Maslin, *Fl. Austrolio* 11A: 599 (2001).

Acocio leproso var. *reclinato* (*B.R.Moslin* 5868), Australian Plant Census CHAH (2006).

Illustrotions. L.F. Costermans, *Notive Trees & Shrubs SE Austrolio* 311, fig.a (1981); T. Tame, *Acocios SE Austrolio* 109, fig. 107f–h, pl. 105 (1992); T.J. Entwisle *et al., Fl. Victorio* 3: 622, fig. 125*c* (1996); B.R. Maslin, *Fl. Australio* 11A: 595, fig. 84M (2001).

Aromatic, rounded or ±narrowly obconic, single-stemmed *shrubs* 2–4 m tall, main stems to about 3 cm in diam., crowns moderately open with ultimate branchlets sometimes arching downwards. *Bork* smooth and grey. *New shoots* light green and slightly shiny. *Bronchlets* straight or very slightly flexuose, somewhat angled at extremities but ageing terete, finely ribbed, the ribs raised, yellowish or red-brown and glabrous or very sparsely appressed-puberulous (hairs to c. 0.5 mm long), inter-rib space wider than the ribs, light brown to dark red-brown and with a thin veneer of resin. *Stipules* caducous. *Phyllodes* narrowly elliptic to lanceolate-elliptic, rarely ±linear, mostly (40–)50–90(–100) mm long, (2–)3–6 mm wide, rarely wider (8–12), shallowly to moderately incurved, sometimes straight, viscid or not viscid (when fresh), slightly shiny, thin-textured, dark green, glabrous or sparsely appressed-puberulous on mid-rib and margin, puncticulate with numerous, evident, shallow, circular depressions that often exude a glistening resin (the punctae are often blackish when dry and darker-coloured than the surrounding lamina: observe at ×10 mag.); with 1 *longitudinol nerve* on each face, this midrib fine yet evident, yellow and slightly raised when dry; *loterol nerves* few and very obscure or very often superficially absent, sometimes (on broadest phyllodes) distally coalescing to form a very obscure, continuous, uneven intra-marginal nerve on either side of phyllode; *opices* acute to short-acuminate, sometimes obtuse-mucronate (mucro central); *pulvinus* c. 1 mm long, glabrous or appressed-puberulous. *Gland*

situated on upper margin of phyllode 0(–0.5) mm above the pulvinus, not prominent. *Inflorescences* simple or occasionally very rudimentary 1-headed racemes 0.5–1 mm long, (1–)2(–4) per axil; *peduncles* 4–8(–10) mm long, c. 0.5 mm diam., moderately densely and rather loosely pubescent, the hairs tolerably long (to c. 0.5 mm), appressed, sub-appressed or somewhat spreading and straight to shallowly curved or wavy; *basal peduncular bract* caducous or sometimes persistent to anthesis, navicular, acute to acuminate, c. 1.5 mm long, dark brown, glabrous; *heads* globular but when in bud often obloid, c. 11 mm diam. when fresh, c. 8 mm diam. dry, 30–50-flowered, lemon yellow. *Bracteoles* exserted beyond flowers in young buds but not exserted in mature buds, lanceolate, 1.2–1.5 mm long (slightly longer than the calyx), dark brown, the laminae large (longer than the very short claws), acuminate to short-acuminate and appressed hairy (especially near margins). *Flowers* 5-merous; *calyx* gamosepalous, 1/2–2/3 length of corolla, shortly lobed, sparsely to moderately puberulous; *petals* sparsely appressed-hairy at apex (sometimes a few glabrous), c. 2 mm long. *Pods* linear, 20–60 mm long, 3–4 mm wide, raised over seeds along mid-line, shallowly curved, chartaceous, glabrous to very sparsely appressed-puberulous, marginal nerve indistinct. *Seeds* longitudinal in the pods, obloid, 3.5–4.5 mm long, 1.5–2 mm wide, shiny, black; *funicle* normally expanded into a twice-folded terminal *aril*. Plates 1 & 2. Fig. 17.

Selected specimens examined: **VICTORIA:** Lilydale, 24.ix.1906, *anonymous* (MEL 1500496); Woori Yallock, 20.x.1905, *anonymous* (MEL 1500478); Melbourne suburban area, Pamela Drive, Ringwood, 5.viii.1984, *D.E. Albrecht 635* (BRI, CBG, MEL, PERTH); Lower Ferntree Gully, Jul. 1942, *C. Davis* 9 (NSW); W side of Courtneys road, 1 km N from Wellington Road, South Belgrave, c. 45 km E of Melbourne, 29.viii.1993, *P.C. Jobson 2129 & A.J. Raisums* (BRI, CANB, MEL, NSW, S); Baluk William Flora Reserve, Courtneys Road, 19.xii.1995, *D.J. Murphy 18* (MEL, PERTH); Myrniong Creek, Sep. 1899, *C. Walter s.n.* (NSW 167421).

Distribution and habitat: Endemic in Victoria where it is restricted to the vicinity of the Dandenong Ranges east of Melbourne. It grows from Ringwood to Lilydale and Woori Yallock then south to Dandenong township; an early collection by C. Walter said to have been gathered from Myrniong Creek (10 km NW of Bacchus Marsh,) is possibly an error or an introduction to that area; there are no other known collections of *A. stictophylla* from this locality. It is common in the places where it occurs. Maslin (2001, p. 599) provisionally referred the specimen *A.C. Beauglehole 30149* (MEL) from the Grampians to this species; this specimen is now known to be *A. verniciflua*. *Acacia stictophylla* grows on hillsides in tall *Eucalyptus* forest or open woodland, on moderately steep slopes under *Eucalyptus* or sometimes in wet riparian vegetation along watercourses. It is found on white sandy loam or clay derived from Silurian sandstone or mudstone. Fig. 16B.

Conservation status: According to the criteria of the IUCN *A. stictophylla* is regarded as Vulnerable (VU C1 *sensu* IUCN 2001). This taxon occurs in conservation reserves but is at risk due to ongoing urban development across its range.

Flowering and fruiting period: Flowers from August to mid November. Pods with mature seeds have been collected in December, however, too few have been seen for us to ascertain range of fruiting.

Variation: Normally the phyllodes on *A. stictophylla* are 3–6 mm wide but they are occasionally wider with the broadest ones (to 12 mm) occurring on a few plants from near Belgrave (e.g. *D.J. Murphy 18*). Wide phyllode forms of *A. stictophylla* may superficially resemble *A. leprosa* var. *uninervia* (the distribution of the two taxa overlap around Woori Yallock) but the latter is most easily distinguished by its gland being located 2 mm or more above the pulvinus (gland ±at distal end of pulvinus in *A. stictophylla*); also, the indumentum and other characters discussed under *Affinities* below that separate *A. leprosa* var. *leprosa* from *A. stictophylla* apply also to *A. leprosa* var. *uninervia*. On a few specimens from around Belgrave the branchlet ribs approach those of *A. verniciflua* (e.g. *P.C. Jobson 2129 & A.J. Raisums*).

Affinities: *Acacia stictophylla* is related to *A. leprosa*, especially the typical variety which occurs in New South Wales and Queensland; these taxa are most easily distinguished by their bracteole morphology and peduncle indumentum, but as noted below there are other characters that separate them. The bracteoles of var. *leprosa* are less conspicuous than those of *A. stictophylla*, they have short, acute laminae (which are less than half the length of the narrowly oblong claws) that are not exserted in the flower buds; by contrast the bracteole laminae in *A. stictophylla* are rather large (longer than the very short claws), acuminate and extend beyond the flowers in young buds (but not the mature buds). The peduncles of var. *leprosa*

are generally shorter than those of *A. stictophylla* but more importantly they have a dense indumentum of uniformly very short, straight, closely appressed hairs that often ±obscure the surface of the peduncles. In *A. stictophylla* the peduncle indumentum is a little less dense and comprises hairs that are about twice as long as those found on var. *leprosa*, furthermore the hairs are more curved and less closely appressed, they form a much looser and open indumentum than that which is found in var. *leprosa*. These different indumentum types are also found on the branchlet ribs of the two species. Variety *leprosa* has generally fewer flowers in the heads (20–30) than *A. stictophylla* (30–50).

Plants of *A. stictophylla* with very narrow phyllodes

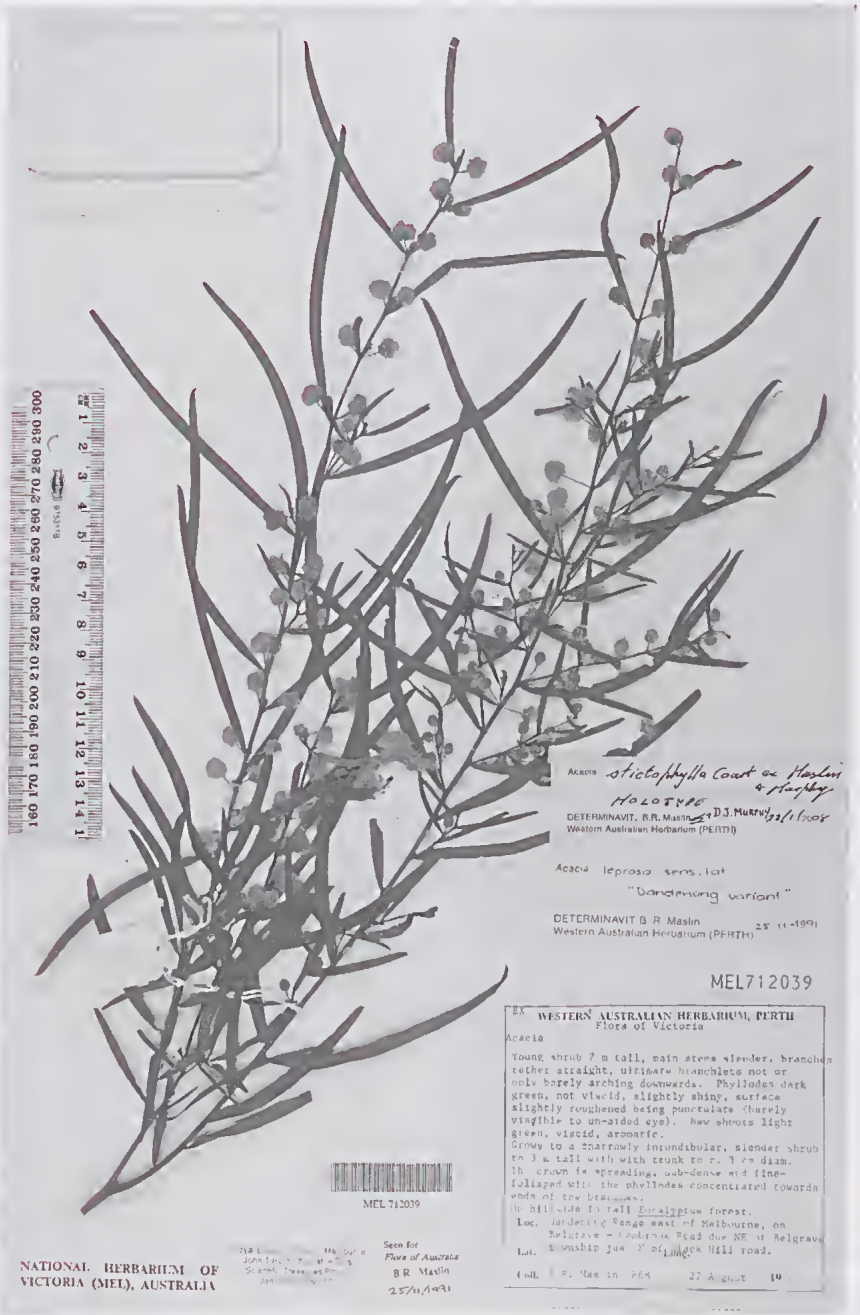
Acacia stictophylla Court ex Maslin & Murphy
HOLOTYPE
DETERMINAVIT. B.R. Maslin D.J. Murphy
Western Australian Herbarium (PERTH)
Acacia leprosa sens. lat
"Dandenong variant"
DETERMINAVIT B R Maslin
Western Australian Herbarium (PERTH)
MEL712039
WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Victoria
Acacia
Young shrub 7 m tall, main stems slender, branches
tether straight, ultimate branchlets not or
only barely arching downwards. Phyllodes dark
green, not viscid, slightly shiny, surface
slightly roughened being punctulate (barely
visible to un-aided eye). New shoots light
green, viscid, aromatic.
Grows to a narrowly inundibular, slender shrub
to 3 m tall with with trunk to c. 7 cm diam.
Th crown is spreading, sub-dense and fine-
foliaged with the phyllodes concentrated towards
ends of tw branches.
On hillside in tall Eucalyptus forest.
Loc. Jordanite Range east of Melbourne, on
Belgrave - Cockatoo Road due NE of Belgrave
township jus [illegible] of Lindeck Hill road.
Lat.
Coll. [illegible] 27 August 19
MEL 712039
NATIONAL HERBARIUM OF
VICTORIA (MEL), AUSTRALIA
Seen for
Flora of Australia
B R Maslin
25/11/1991

Figure 17. *Acacia stictophylla*. Holotype (*B.R. Maslin* 5868), herb. MEL specimen.

superficially resemble *A. cognata* which is distinguished by its normally 3-nerved phyllodes which are very obscurely puncticulate (observe carefully at ×10 mag.) and by its persistent basal peduncular bracts (normally caducous in *A. stictophylla*). Furthermore, *A. cognata* attains a taller stature than *A. stictophylla* (it grows as a shrub or tree 3–10 m high) and in Victoria does not extend west of Orbost on the south coast (about 300 km due east of the Dandenongs where *A. stictophylla* occurs).

Hybrids: Based on morphological criteria the following specimens which were collected from Pamela Place, Ringwood (a suburb of Melbourne), probably represent a hybrid between *A. howittii* and *A. stictophylla*: *D.E. Albrecht 651 & 652* and *B.R. Maslin 582* (all at MEL and PERTH). These plants are characterised by lanceolate to elliptic, short phyllodes (30–40 mm long); they occurred in remnant bushland in a built-up area together with the two putative parents. *Acacia stictophylla* also appears to hybridise with *A. paradoxa* in this same general area, e.g. *B.R. Maslin 5865* (K, MEL, PERTH) which grew with both putative parents. This putative hybrid is the same entity that was reported by Court (1972, p. 216) under *A. leprosa* × *armata*.

Common name: Dandenong Cinnamon Wattle

Etymology: The species name is derived from the Greek *sticto-* (punctured, spotted, dappled) and *phyllon* (leaf) in allusion to the puncticulate phyllodes.

5. *Acacia verniciflua* A.Cunn., *in* B. Field, *Geogr. Mem. New South Wales* 344 (1825)

Racosperma vernicifluum (A.Cunn.) Pedley, *Austrobaileya* 2: 357 (1987). *Type citation*: "Rocky Hills, near Cox's River, &c. Collected first in 1817 by me [A. Cunningham], during Mr. Oxley's Expedition." ***Type***: Cox's River, New South Wales, Oct. 1822, *A. Cunningham 220*; *holotype*: K; *isotype*: BM.

Acacia virgata G.Lodd., *Bot. Cab.* 13: t. 1246 (1827), *nom. nud.* (plate not accompanied by analysis).

Acacia binervata Dehnh., *Cat. horti camald.* 2nd edn, 17 (1832), *nom. illeg., non* DC. (1825). *Type citation*: "Nov. Holl. Flor. Mart.". *Type*: cultivated at the Camalduli botanic garden, Naples, Italy, *F. Dehnhardt*; *holotype*: W.

Acacia gracilis Dehnh., *loc. cit. Type citation*: "Nov. Holl. Flor. Aug. Septemb.". *Type*: cultivated at the Camalduli botanic garden, Naples, Italy, *F. Dehnhardt*; *holotype*: W.

Acacia verniciflua var. *pendula* Seem., *Verh. K. K. Gartenbauges. Wien* 1846: 42 (1846). *Type citation*: "Ob in Garten erzeugt oder auch im Vaterlande versomme ist mir unbesannt". *Type*: *n.v.*

Acacia reclinata F.Muell., First Gen. Rep. Govt. Bot. 12 (1853), *nom. nud.*; *J. Proc. Linn. Soc., Bot.* 3: 131 (1859), *pro syn.* sub *A. leprosa*. Note: it is perhaps equivocal as to whether or not Mueller's name was validly published in 1859; Chapman (1991, p. 77) considers that it was, but Maslin (2001, p. 598) treated it as it is presented here.

Acacia leprosa var. *binervis* F.Muell., *J. Proc. Linn. Soc., Bot.* 3: 131 (1859). *Type citation*: "In collibus graniticis ad flumen Broken River." *Type*: on granite hills between the Broken River and Miles Creek, Victoria, 10.ii.1852, *F. Mueller s.n.*; *holotype*: MEL 1529061.

Acacia leprosa var. *tenuifolia* Benth., *Fl. austral.* 2: 358 (1864). *Type citation*: "Between the Goulburn and Broken rivers, Victoria, F. Mueller." *Type*: between the Goulbourne [Goulburn] and Broken Rivers, Victoria, F. Mueller *s.n.*; probable *holotype*: MEL 1528780; *?isotypes*: K, MEL 1529063 (specimens annotated by F. Mueller as "Trans. fl. Goulbourne").

Acacia verniciflua (common variant) sensu T.J. Entwisle *et al., Fl. Victoria* 3: 617 (1996).

Acacia verniciflua first variant sensu B.R. Maslin, *Fl. Australia* 11A: 597 (2001).

Acacia leprosa (Seymour variant) sensu T.J. Entwisle *et al., Fl. Victoria* 3: 620 (1996).

Acacia leprosa third variant sensu B.R. Maslin, *Fl. Australia* 11A: 599 (2001).

Illustrations. W.J. Hooker, *Bot. Mag.* 60: t. 3266 (1833); N.T. Burbidge & M. Gray, *Fl. Austral. Cap. Terr.* 199, fig. 193G (1970); G.M. Cunningham *et al., Pl. W New South Wales* 374 (1981); D.J.E. Whibley & D.E. Symon, *Acacias S. Australia* 2nd edn, 181 (1992); T.J. Entwisle *et al., Fl. Victoria* 3: 615, fig. 124i and 622, fig. 125b (1996); B.R. Maslin, *Fl. Australia* 11A: 595, fig. 84A–E & N (2001).

Non-aromatic or slightly aromatic, often viscid *shrubs* mostly 1–3 m tall, occasionally small *trees* to 4 m, single- or multi-stemmed, the main branches slender and erect or pendulous. *Bark* grey and smooth, may become rough on older trunks. *New shoots* usually shiny and resinous. *Branchlets* straight to flexuose and/or pendulous, terete or slightly angled, glabrous or occasionally (in few South Australian specimens) minutely appressed-puberulous, normally marked with broad (0.5–1 mm wide), ±flat or

scarcely raised, yellow or green bands that sometimes age brown in dry material and sometimes have a very narrow (<0.5 mm wide), raised nerve along their midline, intersticies (i.e. the region between the bands) often dark red-brown and filled with resin which may be elevated above the bands to form a discontinuous or crenulated "resin rib" (especially in plants near Seymour, Victoria). *Stipules* caducous. *Phyllodes* very variable in shape and size, elliptic to narrowly elliptic, sometimes lanceolate or (when very narrow) rarely linear, sometimes narrowly oblong to oblong-oblanceolate, usually 20–80 (–90) mm long and (1.5–)3–15(–24) mm wide, straight, incurved or sometimes shallowly sigmoid, usually shiny or viscid-resinous but sometimes dull and not viscid, thinly coriaceous, light green to grey-green or dark green, glabrous or rarely sparsely appressed-puberulous on margins and main nerves (mainly in few South Australian specimens), obviously *punctate* with ±numerous, shallow depressions that are often filled with resin; 2 *longitudinal nerves* on each face, the nerves of equal prominence or the adaxial one sometimes poorly developed, rarely 1-nerved (near Seymour, Victoria); *lateral nerves* superficially absent or obscure when dry, anastomosing to form an open reticulum; *apices* acute to obtuse-mucronate (mucro normally ±central); *pulvinus* 0.5–1.5 mm long, glabrous. *Gland* situated on upper margin of phyllode 0–2 mm above pulvinus, circular to ±elongated. *Inflorescences* simple and 1–3 per axil or 2–6-headed racemes with axes to 2–5 mm long; *peduncles* (3–)4–15(–20) mm long, often resinous, glabrous to sparsely appressed-puberulous, the hairs straight and appressed; *basal peduncular bract* early caducous or occasionally persistent to anthesis, navicular, acuminate, 0.5–2 mm long, dark brown, glabrous; *heads* globular to slightly obloid, 30–60-flowered, bright lemon yellow to golden. *Bracteoles* normally obscure and over-topped by flowers in mature buds, very rarely exserted, normally spathulate and 1–1.5 mm long (±equal in length to calyx), the dark brown laminae shorter or longer than the narrowly oblong claws, puberulous abaxially and acute to acuminate. *Flowers* 5-merous; *calyx* gamosepalous, shortly lobed, 1/2–2/3 length of corolla, puberulous; *petals* glabrous or puberulous at apex. Pods narrowly oblong to linear, 25–90 mm long, 3–6 mm wide, thinly coriaceous, glabrous, often shiny resinous or viscid when young and ageing to dull and sometimes rugose, marginal nerves indistict or distinct. *Seeds* longitudinal in the pods, obloid to obloid-ellipsoid, 3.5–5 mm long, 2–3 mm wide, shiny, dark brown to black; *funicle* normally expanded into a once-folded terminal *aril*. Plates 1 & 2. Fig. 18.

Selected specimens examined: **Typical variant. SOUTH AUSTRALIA:** Near the summit of North Bold, c. 5.5 km ENE of Clarendon, *L. Haegi 476* (AD); Mt Lofty Range, Torrens Gorge, c. 10 km NE of Adelaide, 10.viii.1966, *E.N.S. Jockson 713* (AD, MEL). **QUEENSLAND:** Amiens, c. 16 km W of Stanthorpe, *G. Word 281* (BRI). **NEW SOUTH WALES:** c. 4.5 km from Denman, 8.ix.1969, *R.G. Coveny 2443* (NSW, PERTH); Rocky Hills near Cox's River, Oct. 1904, *J.H. Maiden & R.H. Cambage s.n.* (NSW); S of Seymour turn-off on Northern Highway between Heathcote and Pyalong, 27.viii.1985, *B.R. Maslin 5860* (MEL, PERTH); about 3 km SE of Brogedah H.S. on the road to Muswellbrook, 8.ix.1985, *B.R. Moslin 5923* (MEXU, NSW, PERTH); Carboor–Docher road, S of Wangaratta, 19.i.2009, *B.R. Maslin 9946* (MEL, PERTH); 1.2 miles [c. 2 km] S of Capertree Bridge (between Lithgow and Kandos), 25.v.1967, *I.V. Newman 413* (NSW); c. 4.5 km from Denman, 8.ix.1969, *R.G. Coveny 2443* (NSW, PERTH); 22 km from the Mudgee–Dunedoo road intersection towards Cassilis, Oct. 1989, *T. Tome 2554 & 2555* (both PERTH); Between Boat Hill and Grong Grong, 29.ix.1986, *J. Thomos & E. Norris 643* (NSW); **AUSTRALIAN CAPITAL TERRITORY:** Mid N slope of Mt Tennent, *R. Pullen 2923* (CANB). **VICTORIA:** Gippsland Lakes, Hinterland, Mt Difficulty, 29.ix.1985, *D.E. Albrecht 1958* (MEL, PERTH); Grampians, 1.5 miles [2.4 km] ENE of Halls Gap, 21.xii.1968, *A.C. Beauglehole 30149* (MEL); Chiltern State Park, near Cyanide Dam, 22.viii.1994, *R.J. Fletcher 288* (MEL); Mount Cole State Park, Ferntree Waterfalls Road, 27.ii.1996, *D.J. Murphy 37 & N. Middleton* (MEL, PERTH); The Grampians, c. 4 km N of Zumsteins, 8.ix.1985, *S.T.W. Parfett 56* (MEL, PERTH); **Large bracteole variant. VICTORIA:** 0.5 km E of Heathcote–Tooborac road on Seymour–Tooborac road, 4.ix.2004, *B.R. Maslin 8578 & D.J. Murphy* (MEL, PERTH); 17 miles [27.3 km] from Lancefield on road to Tooborac, 9.ix.1972, *C.W.E. Moore 6223* (CANB, MEL, NSW). **Warby Range variant. VICTORIA:** Warby Range, on road skirting N slopes of Mt Killawarra, 29.xi.1972, *E.M. Canning 3242* (CANB, L, A); Ryans Lookout, Warby Ranges State Park, 15 km W of Wangaratta, 11.ix.1970, *P.C. Jobson 110* (MEL); 21 km from Wodonga on Beechworth Road, Feb. 1992, *T. Tome 3326* (NSW). **1-nerved variant. VICTORIA:** Avenel Road (at Hume Hwy overpass). c. 5 km N of Seymour, 4.ix.2004, *B.R.. Moslin 8579 & D.J. Murphy* (MEL, PERTH, K, CANB).

Distribution and habitat: Widespread and common in eastern Australia where it occurs from near Tamworth, New South Wales, south through the Australian Capital Territory to Casterton in Victoria; there are also restricted

occurrences in the Stanthorpe region of southeast Queensland and the southern Lofty Range area near Adelaide, South Australia. Mostly occurs in *Eucalyptus* dominated woodland and grows in a wide range of habitats, from skeletal rocky areas to sand or loam soils derived from granites, sandstones and shales. Generally prefers slopes and rocky hillsides or the banks of watercourses, but is also frequently found in roadside remnants in degraded habitats. Fig. 19.

Conservation status: Based on the widespread occurrence of *A. verniciflua* and its presence in conservation reserves this taxon is regarded as of Least

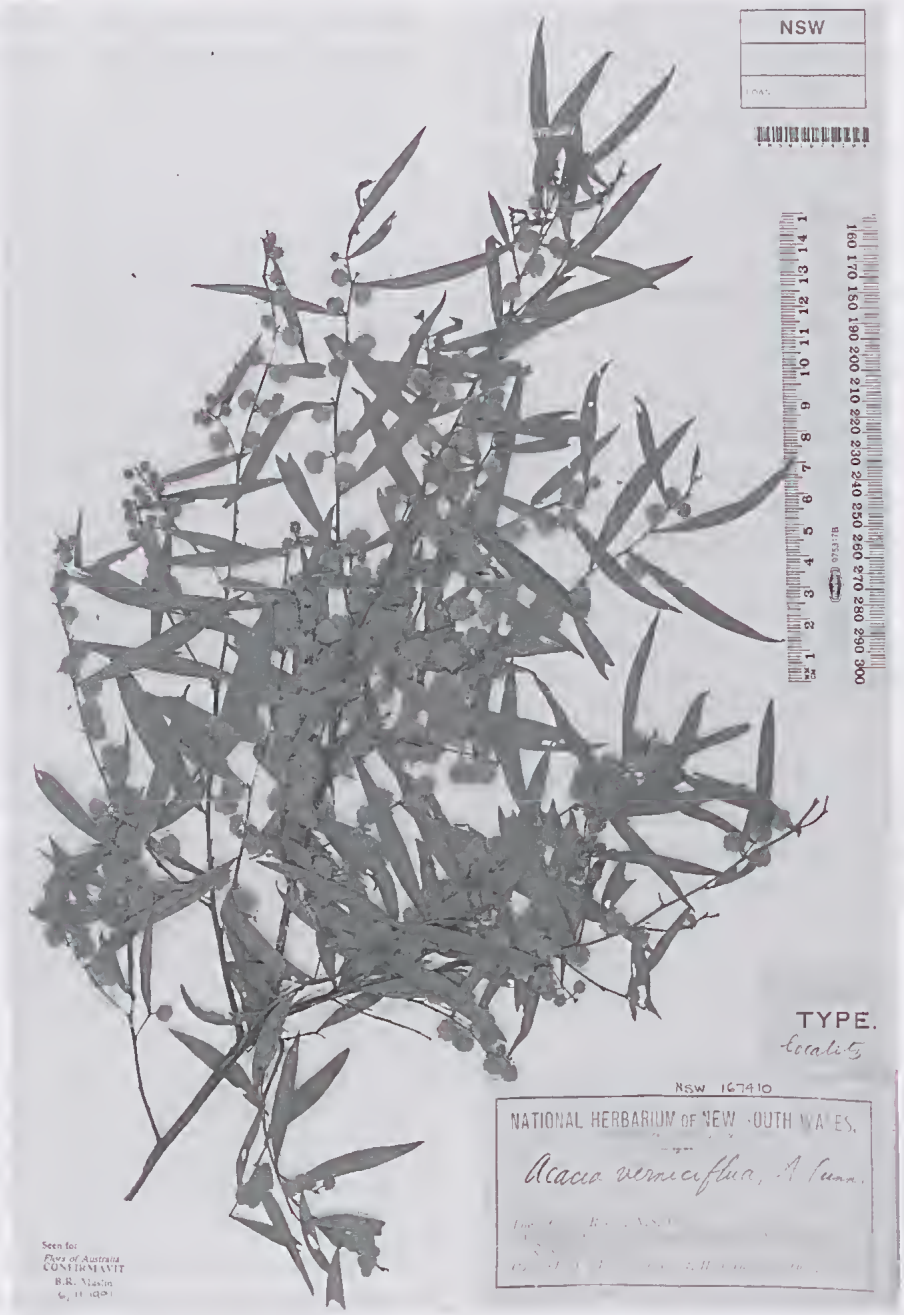

Figure 18. *Acacia verniciflua*. Specimen of typical *A. verniciflua* collected by J.H. Maiden & R.H. Cambage in October 1924 from Cox's River (type locality of the species) at herb NSW.

Concern according to the criteria of the IUCN (LC *sensu* IUCN 2001).

Flowering and fruiting period: Flowers from August to November. Pods with mature seeds have been collected from December to March.

Typification: We have followed Pedley (1979, p. 264) in regarding *Cunningham 220* as the type of *A. verniciflua*.

Taxonomy: Hitherto the definition of *A. verniciflua* encompassed only plants with 2-nerved phyllodes. However, we have broadened the concept of the species through the inclusion of (a few) individuals with 1-nerved phyllodes (these are confined to a small area near Seymour, Victoria). While this is less convenient for the user we believe that this more broadly defined *A. verniciflua* represents a 'good' biological entity that properly reflects the phylogenetic relationships of the included morphotypes.

Variation: In *A. verniciflua* the phyllodes normally have two longitudinal nerves on each face. These nerves can be of uniform prominence but commonly the adaxial one is less prominent than the abaxial (±central) one. In the latter cases the phyllodes could be misinterpreted as being 1-nerved; however, true 1-nerved phyllodes are rare (see below under *Variants*). The phyllode nerves are most easily observed in fresh material (using ×10 magnification with transmitted sunlight); on herbarium material, however, careful observation with a microscope is sometimes needed to accurately determine nerve number. As discussed below under *Variants* the phyllodes of this species are extremely variable in shape and size.

Variants: *Acacia verniciflua* is perplexingly variable, particularly in phyllode shape and size, and this variation does not appear to follow any obvious geographic patterns or clines. While it is possible that future studies may recognise discrete (infraspecific) taxa we have been unable, despite extensive study of a large number of specimens, to justify the establishment of formal taxa to accommodate this variation. Nevertheless, there are some more or less distinctive morphotypes, the most obvious of which are the following. (Note: these morphotypes account for only a relatively small proportion of the total range of variation that exists within the species).

1. 1-nerved variant. Specimens with consistently 1-nerved phyllodes are found only near Seymour, Victoria; they are further characterised by having moderately to strongly incurved, narrow phyllodes (1.5–5 mm wide). These plants correspond to the entities described as *Acacia leprosa* var. *tenuifolia* Benth. (Fig. 20) and *Acacia reclinata* F.Muell (e.g. *B.R. Maslin 8579 & D.J. Murphy*). However, typical 2-nerved *A. verniciflua* occurs also in the vicinity of Seymour and there are a number of specimens that are intermediate for nerve number (including the type of *A. leprosa* var. *binervis* F.Muell.). Because there appears to be no sharp discontinuity between the 1- and 2-nerved individuals we have refrained from attributing formal status to the Seymour entity. Nevertheless, future studies may suggest that formal recognition of var. *tenuifolia* is warranted. There are also a few specimens from New South Wales with narrow, prominently incurved phyllodes, which although 2-nerved the second nerve may be poorly developed (e.g. *J. Thomas & E. Norris 643; B.R. Maslin 5923*).

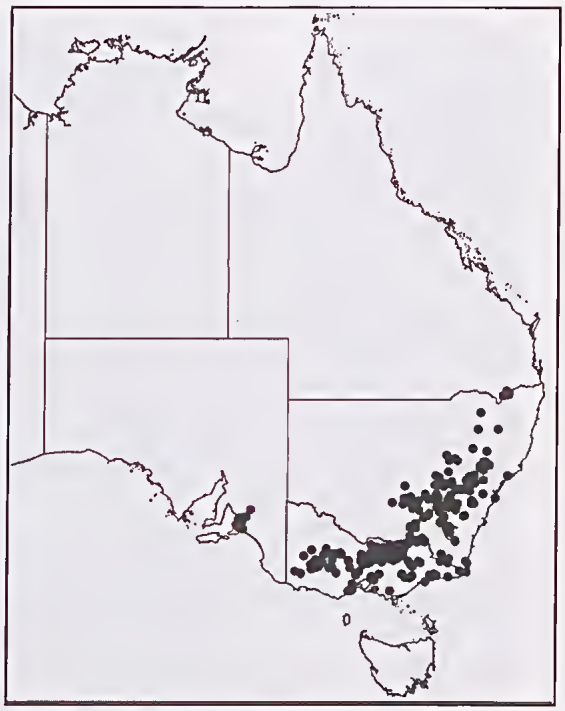

Figure 19. Distribution map for *A. verniciflua*.

2. Warby Range variant. Specimens with very wide phyllodes occur in the Warby Range about 10 km W of Wangaratta, and also near Beechworth, Victoria (e.g. *E.M. Canning 3242*). These specimens have more obvious than normal lateral nerves on their phyllodes. The Warby Range plants also have a distinctive field facies by their flexuose, pendulous branchlets. Similar wide phyllode entities occur throughout the range of the species.

3. Large bracteole variant. Near Tooborac, Victoria, there is a variant characterised by its large bracteoles (c. 2 mm long), long peduncles, short ± elliptic and grey-green phyllodes (e.g. *C.W.E. Moore 6223*). These distinctive bracteoles are similar to those found in *A. leprosa* var. *crassipoda* and *A. exudans*. They are exserted beyond flowers in young buds but not exserted when the buds are mature, are c. 2 mm long (equal in length to corolla) and have acuminate laminae that are densely pubescent abaxially and have a prominent central nerve. Plate 1.

We also note specimens with straight, narrow phyllodes (2–3 mm wide × 30–45 mm long) occuring in the Grampians, Victoria (e.g. *A.C. Beauglehole 30149*).

Continued on p. 223

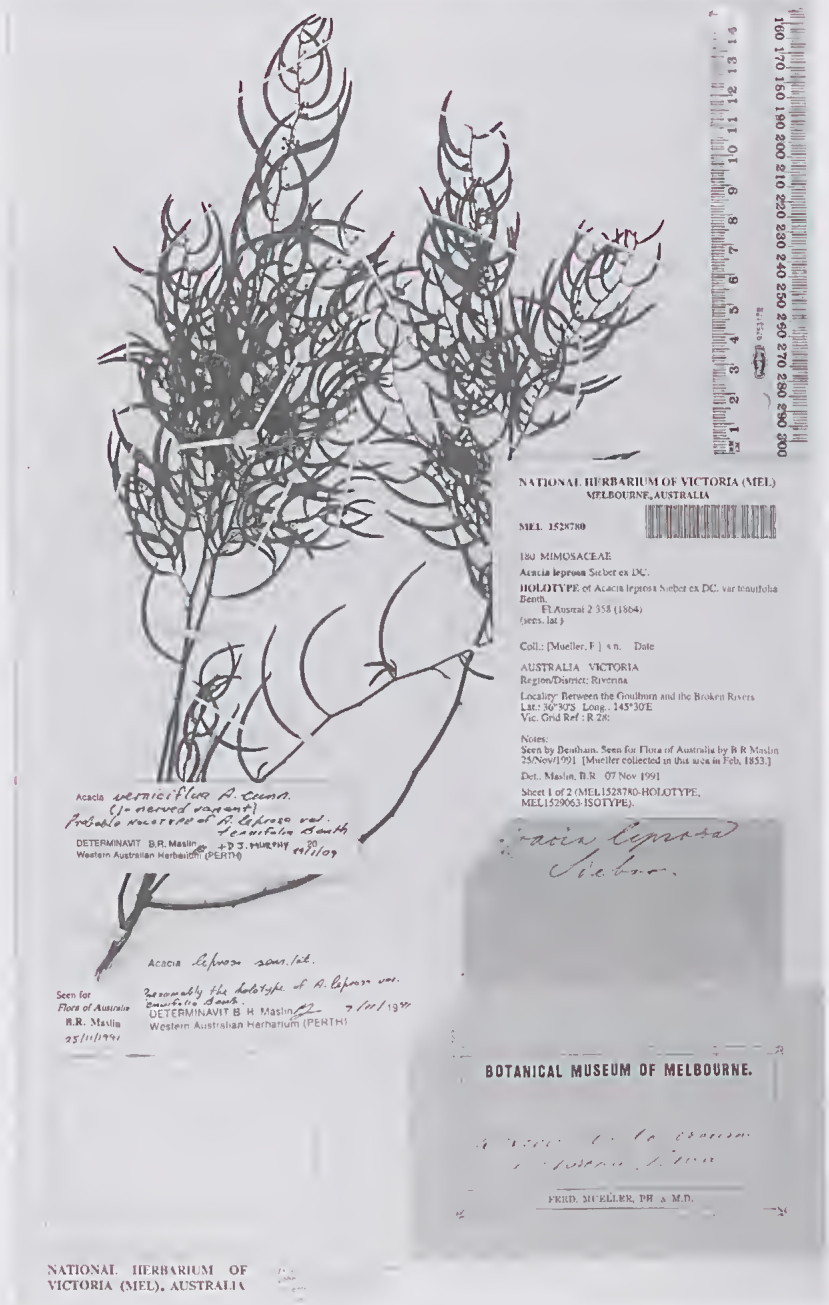
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 1528780
180 MIMOSACEAE
Acacia leprosa Sieber ex DC.
HOLOTYPE of Acacia leprosa Sieber ex DC. var tenuifolia Benth.
FLAustral 2 358 (1864)
(sens. lat.)
Coll.: [Mueller, F.] s.n. Date
AUSTRALIA VICTORIA
Region/District: Riverina
Locality: Between the Goulburn and the Broken Rivers
Lat.: 36°30'S Long.: 145°30'E
Vic. Grid Ref.: R 28
Notes:
Seen by Bentham. Seen for Flora of Australia by B R Maslin 25/Nov/1991 [Mueller collected in this area in Feb, 1853.]
Det.: Maslin, B.R. 07 Nov 1991
Sheet 1 of 2 (MEL1528780-HOLOTYPE, MEL1529063-ISOTYPE).
Acacia verniciflua A. Cunn. (1-nerved variant) Probable HOLOTYPE of A. leprosa var. tenuifolia Benth.
DETERMINAVIT B.R. Maslin Western Australian Herbarium (PERTH)
+D.J. MURPHY 19/11/09
Acacia leprosa sens. lat.
Seen for Flora of Australia B.R. Maslin 25/11/1991
Presumably the holotype of A. leprosa var. tenuifolia Benth.
DETERMINAVIT B. R. Maslin
Western Australian Herbarium (PERTH)
Acacia leprosa Victoria.
BOTANICAL MUSEUM OF MELBOURNE.
FERD. MUELLER, PH. & M.D.
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 20. *Acacia verniciflua* (1-nerved variant). Holotype (*F. Mueller s.n.*) of *A. leprosa* var. *tenuifolia* at herb. MEL.

Plate 1. The *in situ* habit of some taxa in the *Acacia verniciflua – A. leprosa* group in Victoria.
Clockwise from top left. *Acacia leprosa* var. *crassipoda,* Pyrenees Range near Avoca, *B.R. Maslin 8576 & D.J. Murphy (type). Acacia rostriformis*, north of Bacchus Marsh, *B.R. Moslin 8575 & D.J. Murphy (type). Acacia verniciflua* (Large bracteole variant), near Tooborac, *B.R. Maslin 8578 & D.J. Murphy. Acocio vernicifluo (typical variont)*, Mount Ida, with *B.R. Moslin 5859. Acocio stictophyllo,* Belgrave, *B.R. Maslin 5868 (type).* Photographs B.R. Maslin.

Plate 2. Flowering branchlets of some taxa in the *Acacia verniciflua – A. leprosa* group in Victoria. Clackwise fram top left. *Acacia leprosa* var. *crassipada,* Pyrenees Range near Avoca, *B.R. Maslin 8576 & D.J. Murphy. Acacia rastrifarmis,* Lang Farest Canservatian Reserve, *B.R. Maslin 8574 & D.J. Murphy (type). Acacia verniciflua,* Maunt Ida, *B.R. Maslin 5859 (typical variant). Acacia stictophylla,* Belgrave, *B.R. Maslin 5868 (type).* Phatagraphs B.R. Maslin.

Continued from p. 220

Specimens of typical *A. verniciflua* (with incurved and/or wider phyllodes) occur also in this same area. Similar short straight phyllode plants occur in New South Wales; in these specimens the second nerve on the phyllodes is sometimes not well developed (e.g. *I.V. Newman 413*).

Affinities: Judging from the presence of broad, flat bands of tissue associated with the branchlet ribs it seems probable that *A. verniciflua* is most closely related to *A. exudans* and *A. rostriformis*. *Acacia verniciflua*, however, differs from both these species by having glabrous or sparsely appressed-puberulous peduncles and (with some very rare exceptions in South Australia) glabrous branchlets and pods. There are superficial similarities between *A. verniciflua* and 2-nerved varieties of *A. leprosa* but *A. leprosa* is distinguished by its raised, normally appressed-hairy branchlet ribs, generally less overall resinous appearance (especially on branchlets), fewer flowers per head, and more numerous and obvious lateral nerves on the phyllodes.

Common name: Varnish Wattle.

Etymology: According to Hall and Johnson (1993) the species name is derived from the neo-Latin *vernix, vernicis*, from a non-classical word of Romance languages, *vernis* (dissolved resinous material, varnish). It alludes to the varnished appearance of the phyllodes, which is most noticeable in fresh material.

Acknowledgements

The authors wish to thank Mr Arthur B. Court (Canberra, formerly from the National Herbarium of Victoria) for generously providing useful information concerning variation of *A. leprosa* and *A. verniciflua* (see under *Introduction* above). Paul Wilson is thanked for providing the Latin descriptions. DM thanks Pauline Ladiges for her generous assistance with this research and the Australian Plants Society Maroondah group for their support and advancement of research on *Acacia*. We would also like to acknowledge the directors of AD, BRI, CANB, NSW, and HO and thank them for their access to loan material. This work was conducted at the Western Australian Herbarium (PERTH), The University of Melbourne, School of Botany and the National Herbarium of Victoria (MEL); with particular thanks to H Barnes, Curation Officer (MEL), and N. Klazenga (MEL).

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A new *Hakea* species (Proteaceae: Grevilleoideae) from East Gippsland, Victoria

a253187

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Abstract

A new species of *Hakea* Schrad. & J.C.Wendl. with a restricted known distribution in the Alpine National Park, East Gippsland, Victoria, *H. asperma* Molyneux & Forrester sp. nov. is described and illustrated. Its relationships with *H. lissosperma* R.Br and *H. microcarpa* R.Br are discussed and critical differences noted. The new species, while flowering freely, has not been observed to set fruit and apparently relies on ramet production for its persistence.

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Introduction

In 2001, during field studies on populations of mallee eucalypts in the Upper Buchan River district of East Gippsland, we observed a low-growing, multi-stemmed *Hakea* in association with the mallee eucalypts. While this new entity closely resembles *H. lissosperma* (which occurs in the region), the dwarf, root-suckering habit of this population represent two significant character states not recorded for *H. lissosperma* (Barker *et al.* 1996, 1999). The stem diameter at ground level of the new species *H. asperma* is ± 12–15 cm at ground level, compared with a trunk diameter of c. 140 cm in a specimen of *H. lissosperma* on the Bogong High Plains.

Hakea microcarpa R.Br. is a widespread species common in moist to wet sites such as along the upper Buchan River. Populations of this species occur within two hundred metres of *H. asperma*. *Hakea microcarpa* is a small, mostly open, much branched shrub with both terete and flattened leaves, often seen on the same plant. It has scattered silky hairs on the floral rachis and has small fruit that sheds seed upon ripening in the first year. This species is known to regenerate at the base of stems following fire or flood damage. In comparison, *H. asperma* extends by single ramet production along buried (or occasionally exposed) roots (its obligate method of population extension), has only terete leaves, a sericeous rachis, and sets no fruit.

While pollen has been observed escaping from anthers of *H. asperma*, no testing has been undertaken by the authors to ascertain its viability, nor whether any fertilisation takes place. Future DNA studies may shed light on the inability of *H. asperma* to set fruit. A further example of taxa producing pollen but not setting seed was discussed by the authors in a paper describing three new *Acacia* species from East Gippsland, to the east of the *H. asperma* population (Molyneux & Forrester 2008).

As *H. asperma* persists by ramet production, the term ramet is used throughout this paper to describe the whole above-ground entity, rather than using the potentially confusing terms 'plant' or 'stem'.

However, terms such as 'stem' or 'leaf' are used to describe those parts of the entity when relevant.

Our initial survey estimated the area occupied by the species at c. 0.15 ha, with the population comprising an estimated 1000 individual ramets. In the summer of 2002 this region was severely burnt in a localised fire, a year prior to the widespread summer fires of 2003 in this region of Victoria. The *H. asperma* population, together with the mallee eucalypts, was severely damaged. Returning to the site in May 2003, we observed some ramet production up to 10 cm high. By 2006 the *Hakea*, together with the eucalypts, had regenerated strongly and in November 2008 we collected flowering specimens of *H. asperma*. At this time we observed that the *H. asperma* population now covered c. 0.2 ha with the number of ramets estimated at 2000. Future study may indicate whether the observed extent of post-fire vegetative recruitment is maintained or limited by competition from other species.

Herbarium records reveal no collections of the taxon prior to the present study. Populations of *H. lissosperma* have been recorded by Wakefield c. 5 km to the east in the Cobberas (MEL1507364, 29.i.1949) and the authors have sighted a substantial population of this species 2-4 m tall c. 23 km south of the *H. asperma* population, south of the Diggers Hole Track on the Nunniong Plateau.

Taxonomy

Hakea asperma Molyneux & Forrester *sp. nov.*

H. lissospermae *R. Br. arcte affinis, in habitu breviore, surculis a radicibus efferentibus et absentia fructorum differt.*

Type: Victoria. Above the north side of Native Dog Falls on the Upper Buchan River, 12.xi.2008, *W.M. Molyneux and S.G. Forrester s.n.* (holo: MEL 2312606, 2328061 (multisheet); iso: AD, CANB, HO, NSW, MEL 2312607, 2328060).

An erect root-suckering *shrub* to 50(–130) cm high, persisting by ramets. *Stems* with smooth grey bark, ± 120–150 mm circumference at ground level; branchlets glabrous. *Leaves* terete (21–) 30–40 or 65–96 (–100) mm long, 0.8–1.3 mm wide, straight, rigidly mucronate, grey-green, glabrous, articulate to and at c. 10–15° to stems, new growth sericeous white, apex hairs ferruginous. *Inflorescence* conspicuously bracteose, axillary, simple. *Flowers* 6–10. *Bracts* oblong, imbricate, white-tomentose on the outer surface, 2.5–3(–4) mm long, 2–2.5 mm wide. *Rachis* 1–1.5 mm long, sericeous. *Pedicels* fine, c. 5 mm long, sparsely sericeous. *Perianth* glabrous outside (or irregularly sericeous at base), 4–4.5 mm long, c. 1 mm wide midway along its length, white, densely sericeous internally at c. midway along its length. *Anthers* yellow, pollen pale lemon. *Style* white, 7–8 mm long, often pink-tinged behind style end, which is oblique at c. 25–33° to the style; pollen presenter flat to convex, margins undulate, stigma short, c. 0.3 mm high; ovary green; nectary white, broadly U-shaped, thick. *Fruit* not produced.

Specimen examined: **VICTORIA**: Above Native Dog Falls on (upper) Buchan River, elevation 1197 m, 19.v.2003, W.M. Molyneux, MEL 2236326, 36°54'26"S 148°05'21"E.

Distribution: *Hakea asperma* is apparently endemic to the Native Dog Flat area of the Upper Buchan River district in East Gippsland, Victoria, where it is presently known from a single population of c. 2000 ramets in an area of c. 0.2 ha above and to the north of Native Dog Falls.

Conservation Status: Using the criteria of the IUCN (2001), the species is assessed as critically endangered, with a conservation code of CR D, on account of its exceedingly small population size, which may comprise no more than a single or very few genetic individuals or genets, which renders the species highly susceptible to extinction by successive fire occurrences or other stochastic events.

Habitat: *Hakea asperma* occurs on the lower slopes of a small steep hill of Devonian igneous origin where sufficient soil depth and area exists to support the root systems between broken, often buried rock. An occasional root is exposed growing over shallow rock.

Associated eucalypts include *Eucalyptus* sp. aff. *stellulata* Sieber ex DC., (an undescribed mallee with several locally endemic populations), a dwarf form of *Eucalyptus pauciflora* Sieber ex Spreng. subsp. *pauciflora*, *Eucalyptus rubida* H.Deane & Maiden and *Eucalyptus viminalis* Labill. subsp. *viminalis*. Other associated species include *Bossiaea foliosa* A.Cunn., *Daviesia latifolia* R.Br., *Daviesia ulicifolia* Andrews, *Goodenia hederacea* Sm., *Lomatia myricoides* (C.F.Gaertn.) Domin, *Persoonia confertiflora* Benth. and *Polyscias sambucifolius* (DC.) Harms.

Figure 1A. *Hakea asperma*: canflarescence; **B.** *Hakea asperma*: 54 ramets in an area of 15 square metres.

Phenology: Flowers early November to mid December.

Etymology: The specific epithet refers to the infecund nature of the species in comparison with *Hakea lissosperma* and *Hakea microcarpa*.

Recommended English name: Native Dog Hakea.

Acknowledgements

Our thanks to Neville Walsh for the Latin diagnosis and for ongoing discussions of a broader botanical nature; to David Cameron for editorial assistance and advice regarding the conservation status of this new species; and to the staff at MEL for access to and assistance with collections.

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Eucalyptus ambigua DC. (Myrtaceae), the correct name for the Smithton Peppermint of Tasmania

a 253195

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Introduction

The French botanist J.J.H. de Labillardière was the first to make major collections of Tasmanian plants in two visits (April–May 1792 and January–February 1793) during the voyage led by B. d'Entrecasteaux (Labillardière 1800; Douglas-Hamilton & Bruce 1998). His Tasmanian collections included an unknown number of *Eucalyptus* specimens that were used to name seven species: *E. globulus* Labill. (in 1800); *E. ovata* Labill., *E. viminalis* Labill., *E. cordata* Labill. and *E. amygdalina* Labill. (in 1806); *E. ambigua* DC. (in 1828) and finally *E. pulchella* Desf. (in 1829).

Labillardière (1800) provided a detailed account of the events of the voyage, from which it is obvious that he was a very keen and assiduous botanist. On his first day on shore at Recherche Bay in Tasmania (23rd April 1792), he recorded "I gathered several species of the *eucalyptus*, during this excursion; amongst others, that which White has denominated *eucalyptus resinifera*...". The detail given in Labillardière's journal allows us to precisely fix the time and place of some eucalypt collections. He recorded at some length his collection of *E. globulus* on 6th May 1792, and there can be no doubt that the type material was collected on that day from Recherche Bay. For *E. cordata*, Potts (1988) has provided irrefutable evidence that the type was collected from Penguin Island during the last few days (between the 25th and 28th) of February 1793. However, Labillardière gave us no clues about the location or date of his *E. ambigua* collection.

The history of *Eucalyptus ambigua*

Eucalyptus ambigua was described by A.P. de Candolle in 1828, in volume 3 of the epic *Prodromus systematis naturalis regni vegetabilis*. Candolle's treatment of *Eucalyptus* in the *Prodromus* dealt with all known names, including some whose identity, even then, was unknown or uncertain. While his descriptions are concise, the information conveyed is useful, though often not diagnostic. Most significantly, Candolle consistently stated the source of the specimens used in compiling the descriptions, and sometimes gave short notes about the taxonomic affinity of

Abstract

The original material of *Eucalyptus ambigua* DC. is conspecific with the type of *E. nitida* Hook.f. The name *E. ambigua* is older by almost thirty years, and is therefore the correct name for the Smithton Peppermint. Bentham and Maiden both correctly determined the identity of *E. ambigua*, but the name has been ignored for the last 100 years. *Eucalyptus ambigua* is based on a collection by Labillardière from southern Tasmania. Some eucalypts encountered by Labillardière in Tasmania are discussed.

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the species. In the case of *E. ambigua*, he cited *"In Nova-Hollandia. Labillardière. Affinis E. ligustrinae et E. amygdalinae."*

Eucalyptus ambigua was next mentioned by Bentham (1867). Bentham had a broad concept of *E. amygdalina* that included several taxa now recognised at species rank. He considered *E. tenuiramis* Miq. to be a synonym of *E. amygdalina*. He also reduced J.D. Hooker's *E. nitida* (Hook.f.) Benth. to a variety of *E. amygdalina*, and placed *E. ambigua* as a synonym of *E. amygdalina* var. *nitida*. There are no known authentic specimens of *E. ambigua* at BM or K, and it is clear that Bentham never saw any, as he reached his conclusions "from the diagnosis taken from Labillardière's specimen".

Mueller (1880) mentioned *E. ambigua* only in passing, saying that it "may be a West Australian species, the somewhat leathery leaves, the compressed flower stalks and the almost globular fruit not really pointing to *E. amygdalina*".

The discussion by Maiden (1905, p. 159) in his *Critical revision of the genus Eucalyptus* left no stone unturned, as was his usual working method. He stated that he borrowed "the" type of *E. ambigua* from the Candolle herbarium, and considered its identity to be "probably *E. amygdalina*, tending to var. *nitida*, as suggested by Bentham". He also reported seeing a Labillardière specimen at P, originating from the Webb herbarium. Of this specimen Maiden stated, "This is *E. amygdalina*, var. *nitida*". Maiden was not content to leave it there. He talked about two further specimens named as *E. ambigua*, neither of them authentic, and for one of which he said "seems to be *E. stricta* Sieb." Maiden concluded his analysis by saying "it may be accepted that *E. ambigua*, DC., is allied to *E. amygdalina*, Labill., var. *nitida*. It may, however, be *E. stricta*, Sieb.: another of the Renantherae".

In his *Key to the Eucalypts*, Blakely (1934, p. 315) regrettably distilled from Maiden's discussion "*ambigua* DC. Prod., iii., 219 (1828) = 384, *E. stricta*, Sieb.". More recent authors have continued to honour Blakely's interpretation (e.g. Chippendale 1988; Slee *et al.* 2006). Our current-day knowledge of the distributions of various *Eucalyptus* species makes this synonymy all the more unlikely – *E. stricta* is endemic to the state of New South Wales, while Labillardière (collector of the type of *E. ambigua*) visited only Tasmania and Western Australia.

I have examined some high-quality images of three specimens, all of which are considered to be original material of *E. ambigua*. Two of these specimens are held at G-DC and another is at G. All are in accord with the protologue, and all were presumably available to Candolle when drawing up his description of *E. ambigua*. All three specimens comprise branchlets bearing adult leaves and buds close to maturity, and one of them has some detached fruits in a packet. The leaves are 15–25 mm wide, the buds are clavate, and the hemispherical warty operculum has a tiny mucro. The fruits are 8–9 mm in diameter and are broadest just below the rim. There is no hint of glaucousness on any of the material. I am satisfied that these specimens are conspecific with the type of *E. nitida* Hook.f. In fact, the sheet at G was annotated by G.M. Chippendale in 1973 as "*Eucalyptus nitida* Hook.f. (*E. ambigua* DC. =)". One of the sheets at G-DC (G00131709) is here selected as the lectotype of *E. ambigua*. The formal synonymy is as follows:

Eucalyptus ambigua DC., *Prodr.* 3: 219 (1828).

Type: New Holland [south-eastern Tasmania], undated [1792 or 1793], *J.J.H. Labillardière s.n.* (lecto: G-DC, sheet G00131709, here designated, (image at BRI)).

E. nitida Hook.f., *Fl. Tasman.* 1(2): 137 (1856); *E. amygdalina* var. *nitida* (Hook.f.) Benth., *Fl. austral.* 3: 203 (1867); *E. australiana* var. *nitida* (Hook.f.) Ewart, *Fl. Victoria* 833 (1931), *syn. nov.* Type: Tasmania. Circular Head, 21 January 1837, *R. Gunn 808* (lecto: K [K000279983], *fide* Chippendale (1988); isolecto: BM, NSW).

E. simmondsii Maiden, *Crit. revis. Eucalyptus* 6: 344 (1923). Type: Tasmania. Smithton, 27 May 1921, *J.H. Simmonds s.n.* (holo: NSW, *fide* Chippendale (1988)).

Chippendale (1974) listed six syntypes for *E. nitida*. However, he later (Chippendale 1988) cited Gunn's Circular Head collection of 21/1/1837 at Kew, as the holotype. In so doing, he has lectotypified the name. Under Article 9.8 of the Code, the use of the term "holotype" by Chippendale is correctable to "lectotype".

The name change resulting from this investigation is unfortunate, but it is fitting that Candolle and Labillardière receive the recognition that is due to them. It is the fault of neither of these men that

E. ambigua has wallowed in obscurity for so long. The original description was more than adequate for its time and appeared in a very well known publication. Furthermore the type material is of good quality, is well preserved and is accessible.

Acknowledgements

I am grateful to Laurent Gautier, curator in charge of loans at the Geneva Herbarium, for providing the excellent images of the original material of *E. ambigua*, and to Tony Orchard (Australian Botanical Liaison Officer 2008–09) for alerting me to the presence of relevant images of eucalypt types on the Kew Gardens website.

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Eucalyptus arcana (Myrtaceae), a new combination for a former subspecies of *Eucalyptus splendens* and notes on a population of scentbark occurring near Moonlight Head in south-west Victoria

a 253196

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Abstract

Eucolyptus splendens subsp. *orcono* Nicolle & Brooker is raised to species level as *E. orcona* (Nicolle & Brooker) Rule comb. etstat.nov; and a small population of scentbarks occurring near Moonlight Head in south-west Victoria are confirmed as a variable form of *E. oromophilo*.

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Introduction

An occurrence on basaltic soils to the north-west of Portland, Victoria, of small, rough-barked trees was brought to my attention by the eminent surveyor and collector of Victorian plants, Cliff Beauglehole. These trees, known locally as Apple Jack, were subsequently described (Rule 1996) as *Eucalyptus splendens* Rule. A population of related, depauperate trees and mallees occurring at Carpenter Rocks in lower south-east South Australia was informally treated by Nicolle (1997) in his circumscription of eucalypts of that state. Nicolle and Brooker (1998) subsequently erected *E. splendens* subsp. *arcana* Nicolle & Brooker to accommodate the Carpenter Rocks population. Further studies have indicated that *E. splendens* subsp. *arcana* is sufficiently distinct to warrant it being recognised as a separate species.

***Eucalyptus arcana* (Nicolle & Brooker) Rule** *comb. et stat. nov.*

Eucalyptus splendens subsp. *arcana* Nicolle.& Brooker, *J. Adelaide Bot. Gard.* 18(2): 103 (1998).

Type: South Australia. South-eastern Region: East of Carpenter Rocks township, 26.ii.1997, *D. Nicolle 1978* (holotype: AD; isotype: CANB, NSW, MEL, BRI, HO, K).

Illustration: Nicolle and Brooker (1998) p. 105 (as *E. splendens* subsp. *arcana*).

Distribution and habitat: *Eucalyptus arcana* occurs on shallow, impoverished soils over a limestone substrate about a kilometre to the east and north-east of the coastal town of Carpenter Rocks, lower south-east South Australia.

Associated species: *E. obliqua* L'Her. is an associate and *E. ovata* Labill. occurs nearby.

Conservation status: I concur with the conservation status of 2Vcit which was recommended by Nicolle and Brooker in accordance with Briggs and Leigh (1996).

Affinities: *Eucalyptus splendens* was regarded by Rule (1996) as having affinities with the scentbarks, series *Acaciiformes*, a small group of rough-barked trees with 7-flowered inflorescences, on the basis of its bark, juvenile leaves, buds and fruits being similar to other species of that series. Brooker and Slee (1996) in *Flora of Victoria*, however, tentatively placed the species with the manna gums, series *Viminales*. Nicolle and Brooker (1998), in providing their treatment of *E. splendens* subsp. *arcana*, maintained the view that the affinities of E. *splendens* and the new subspecies are with the manna gums. However, they further noted that the boundaries between the manna gums and the scentbarks are not clearly defined and that a better understanding of the relationship between the groups would be a matter for further research. Nicolle (2006), having apparently reassessed the affinities of the two subspecies of *E. splendens*, reassigned them to the scentbarks.

The current study has assessed the Carpenter Rocks entity as a separate species and, on the basis of seedling morphology and ontogeny, determined that the two taxa in question form a discrete complex with links closer to the scentbarks than the manna gums. Whilst each scentbark species has its individual juvenile leaf shape, with the range of shapes across the species including linear-elliptical and falcate, elliptical, ovate-elliptical or ovate-lanceolate, all species have basally tapered and non-amplexicaul, dull juvenile leaves which become petiolate and disjunct relatively early in the juvenile stage. In the manna gums the juvenile leaves are lanceolate, basally rounded or amplexicaul and lustrous (except for a recently discovered unnamed form which has glaucous juvenile leaves) and remain sessile and opposite for numerous pairs. By comparison, the juvenile leaves of the *E. splendens* complex fit neither combination, being lanceolate, ovate-lanceolate, ovate or broadly ovate, basally tapered and lustrous, and becoming shortly petiolate and disjunct in the juvenile stage at a similar rate to the scentbarks. At this stage, it is viewed here that the relationships of the *E. splendens* complex

Table 1: Comparisons between *Eucalyptus splendens* and *E. arcana* in addition to those of Nicolle & Brooker (1998).

Characters	*E. splendens*	*E. arcana*
Trunks	stout, erect, to 0.75 m diam. at the base	slender, usually leaning, to 0.2 m diam. at the base
Bark	grey-brown, thick, sub-fibrous, deeply fractured	light grey, thin, scaly or tessellated, slightly fibrous at the base
Canopies	foliage relatively dense in appearance, consisting of lanceolate, semi-pendulous leaves	foliage relatively sparse in appearance, consisting of haphazardly oriented, lanceolate and broadly lanceolate leaves
Seedling stems	square in cross-section and winged throughout the juvenile stage	only square in cross-section in early seedling development
Juvenile leaves		
shape	lanceolate, rarely ovate-lanceolate	ovate or broadly ovate
apex	acuminate	apiculate
Adult leaves		
size	10–20 cm long, 1–2.2 cm wide	8–12 cm long, 1–3.5 cm wide
lateral veins	25–35° from mid-vein	35–45° from mid-vein
intramarginal veins	1–2 mm from margin	2–3 mm from margin
Peduncles	6–10 mm long, 1.5–2 mm thick	3–5 mm long, 2–2.5 mm thick
Fruits		
shape	ovoid or sub-globular (5–6 mm long, 4–6 mm diam.)	hemispherical or obconical (5–6 mm long, 6–8 mm diam.)
disc	moderately to steeply ascending	rolled

are unresolved. Ideally, further research, which has a molecular rather than a morphological focus, offers the best prospects for their resolution.

Notes: Nicolle and Brooker (1998, p. 106), in justifying their decision to erect the Carpenter Rocks entity as a subspecies within *E. splendens*, noted that "*E. splendens* subsp. *arcana* differs from *E. splendens* subsp. *splendens* in its consistently low, scraggy habit; the larger, slightly crenulate juvenile leaves; the larger, sessile buds and fruits and the obtuse operculum. Site differences are also apparent with *E. splendens* subsp. *splendens* occurring on much deeper, non-calcareous soils further inland from the coast". However, the authors did not address other differences between the two that indicate they are sufficiently distinct to warrant them being regarded as separate species. Thus, the Carpenter Rocks taxon is here elevated to the rank of species and comparisons other than those offered by Nicolle and Brooker are outlined in Table 1.

Notes on a population of scentbarks occurring near Moonlight Head in south-west Victoria

Nicolle (2006) identified a small population of about 50 plants occurring along Wreck Beach Track near Moonlight Head in south-west Victoria as *Eucalyptus splendens* subsp. *arcana* (here recognised as *E. arcana*). In his descriptions and comments Nicolle noted that this population had been regarded as *E. aromaphloia* L.D.Pryor & J.H.Willis by Chappill *et al.* (1986) in their study of the *E. aromaphloia* complex. In reporting the results of their seedlings trials, Chappill *et al.* (1986) indicated that their Moonlight Head seedlots produced seedlings that were consistent with typical *E. aromaphloia*. From field studies of plants along the Wreck Beach Track and on the hillside above Wreck Beach I became convinced that the population is not *E. arcana* but a variable, depauperate form of *E. aromaphloia*, which superficially resembles that species. In particular, the population shows slight variation in leaf size, operculum shape and fruit size. Such variation is not uncommon in populations of typical *E. aromaphloia*. To confirm this assessment, comparative seedling trials were conducted using four seedlots of trees of typical *E. arcana* and four of trees typical of the Moonlight Head population occurring along Wreck Beach Track. Four or five seedlings representing each seedlot were selected to be grown on to an advanced seedling stage, the purpose of which was to determine conclusively the identity of the Moonlight Head trees. Additional trials were conducted using the same format with seedlots of three more trees from the Moonlight Head population. Not only were the seedlings across all seedlots of the Moonlight Head trees uniform in their morphology, they exhibited the glaucous growth tips and the ovate-elliptical, bluish juvenile leaves that characterise *E. aromaphloia*.

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